KEMESS MINE 2022 ANNUAL IAAC REPORT

Canadian Environmental Assessment Act, 2012

Submitted to:
Impact Assessment Agency of Canada
iaac.compliance-conformite.aeic@canada.ca
22nd Floor, Place Bell
160 Eglin Street
Ottawa, ON
K1A OH3

Submitted by:
AuRico Metals Inc. - Kemess Mine
Centerra Gold
200 - 299 Victoria Street
Prince George, BC
V2L 5B8

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EXECUTIVE SUMMARY

Aurico Metals Inc., a wholly own subsidiary of Centerra Gold Inc., obtained the Canadian Environmental Ministers Decision Statement on March 13, 2017 for the Kemess Underground Mine (KUG), an underground mine located in the mountains of north-central British Columbia (BC), 430 kilometres northwest of Prince George. The Implementation Schedule was provided to Aboriginal groups and the Impact Assessment Agency of Canada (IAAC) in 2017. Construction activities (road building, clearing, etc.) for the Kemess Underground Project Commenced July 16, 2018. In 2020, construction of the KUG project was paused and Kemess Mine was put into Care and Maintenance.

At the mine site, fish and fish habitat protection continues to be achieved through the implementation of erosion and sediment control (ESC) techniques as part of our Care and Maintenance phase of the project. Very limited construction activities are located within the Mine Site Water Management Area (MSWMA). Runoff water from the East Pit Quarry continues to flow into the Kemess Underground (KUG) tailings storage facility (TSF).

All water that reports to the MSWMA is pumped back to the KUG tailings storage facility (TSF). Kemess has implemented supplementary construction site water management and erosion control measures, including the implementation of check dams, French drain features, placement of rip-rap, and hydroseeding efforts. In addition, the SP27 ditch was constructed in 2022 to divert seepage coming from the Waste Rock Dump (WRD) to the Southern Collection System Pond (SCSP) for subsequent pumping back to the KUG TSF.

In 2022, discharge from the KUG TSF was re-initiated to Attichika Creek, which occurred between June 8 to August 6. Substantive effects on most environmental components of Attichika Creek were not observed in 2022: water quality, sediment quality, periphyton communities, benthic invertebrate abundance, composition, and diversity, and fish tissue concentrations were generally consistent within pre-discharge measurements; and were considered consistent with those of healthy aquatic ecosystems in the region. Selenium concentrations of benthic invertebrate and bull trout tissue in Attichika Creek increased in 2022 relative to pre-discharge levels; however, have remained below relevant provincial guidelines for the Protection of Aquatic Life (4 mg/kg dry weight).

Consistent with previous monitoring years, selenium concentrations remain elevated in water, sediments, and biota of Waste Rock Creek, relative to applicable guideline thresholds. However, despite elevated selenium concentrations, substantive effects on benthic and periphyton community productivity or composition were not observed in Waste Rock Creek.

During all snow-laden months in 2022, the Omineca Resource Access Road (ORAR) was not kept open; therefore, there was no need for monitoring to ensure safe passage of ungulates exiting plowed roads. A Hunting, Fishing and Gathering Policy was implemented in 2018 to prohibit fishing, hunting, and trapping within the Project area.

Approximately 0.30 hectares of vegetation was cleared for the construction of the SP-27 ditch. A pre-clearing survey was completed before vegetation removal on July 29th, 2022 including pond areas in close proximity that could be suitable habitat for the Western Toad (*Anaxyrus boreas)*. Similarly, no maternal roosts were discovered for little brown myotis (*Myotis lucifugus*) nor Northern myotis (*Myotis septentrionalis*). No furbearer dens or migratory bird nests were found during the survey. Furthermore, no wildlife mortalities were reported in 2022 due to mine-related activities but mortalities of two ptarmigans were observed due to natural predation by foxes.

During a site tour, an employee noticed a rock that resembled obsidian and had the markings of some kind of tool. The rock was put back in its original location and the site was flagged off with a buffer and signage. The B.C. Archaeological branch and the local indigenous groups were notified of the find. The chance find encounter has been recorded and included within our Annual Heritage Report.

Two environmental incidents occurred at the Kemess Mine site in 2022. On July 5th, an IAAC inspection found some hydrocarbon staining on the ground at the heavy equipment hotline, a laydown area where vehicles are parked. The cause of the staining was determined to be drips of oil or hydraulic fluid from the parked heavy equipment. The surficial nature of the hydrocarbon staining indicated that the volume was not of a reportable quantity per the *BC Environmental Management Act Spill Reporting Regulation*. Under the direction of the inspectors, an Accident and Malfunctions Notification was completed for the incident.

On July 6th, water spilled from a manhole and air vent during routine discharge to Attichika Creek. The spill was estimated to be 9 cubic metres of water from the KUG TSF, which pooled in a gravel laydown and had no impact to the environment.

RÉSUMÉ

Aurico Metals Inc., une filiale en propriété exclusive de Centerra Gold Inc., a obtenu la déclaration de décision des ministres canadiens de l'environnement le 13 mars 2017 pour la mine souterraine Kemess (KUG), une mine souterraine située dans les montagnes du centre-nord de la Colombie-Britannique (Colombie-Britannique), à 430 kilomètres au nord-ouest de Prince George. Le calendrier de mise en œuvre a été fourni aux groupes autochtones et à l'Agence d'évaluation d'impact du Canada (IAAC) en 2017. Les activités de construction (construction de routes, déboisement, etc.) pour le projet souterrain de Kemess ont commencé le 16 juillet 2018.

Sur le site minier, la protection du poisson et de son habitat continue d'être assurée grâce à la mise en œuvre de techniques de contrôle de l'érosion et des sédiments (ESC) dans le cadre de notre phase d'entretien et de maintenance du projet. Des activités de construction très limitées sont situées dans la zone de gestion des eaux du site minier (MSWMA). Les eaux de ruissellement de la carrière East Pit ont continué de s'écouler dans l'installation de stockage des résidus (ISR) souterraine de Kemess (KUG).

Toute l'eau transmise au MSWMA est pompée vers l'installation de stockage des résidus du KUG (TSF). Kemess a mis en œuvre des mesures supplémentaires de gestion de l'eau et de contrôle de l'érosion sur le site de construction, notamment la mise en place de barrages de contrôle, de dispositifs de drain français, de mise en place d'enrochements et d'efforts d'hydroensemencement. En outre, le fossé SP27 a été construit en 2022 pour détourner les eaux d'infiltration provenant de la “Waste Rock Dump” (WRD) vers le bassin du Système de Collecte Sud (SCSP) en vue d'un pompage ultérieur vers le KUG TSF.

En 2022, le déchargement du KUG TSF dans le ruisseau Attichika a repris, entre le 8 juin et le 6 août. La qualité de l'eau, la qualité des sédiments, les communautés de périphyton, l'abondance, la composition et la diversité des invertébrés benthiques, ainsi que les concentrations dans les tissus des poissons étaient généralement conformes aux mesures prises avant le déchargement, et ont été considérées comme conformes à celles des écosystèmes aquatiques sains de la région. Les concentrations de sélénium dans les tissus des invertébrés benthiques et de l'omble à tête plate dans le ruisseau Attichika ont augmenté en 2022 par rapport aux niveaux d'avant la décharge ; cependant, elles sont demeurées inférieures aux lignes directrices provinciales pertinentes pour la protection de la vie aquatique (4 mg/kg de poids sec).

Conformément aux années de surveillance précédentes, les concentrations de sélénium restent élevées dans l'eau, les sédiments et le biote du ruisseau “Waste Rock”, par rapport aux seuils des lignes directrices applicables. Cependant, malgré les concentrations élevées de sélénium, aucun effet important sur la productivité ou la composition des communautés benthiques et du périphyton n'a été observé dans le ruisseau “Waste Rock”.

Pendant tous les mois chargés de neige en 2022, la route d'accès aux ressources d'Omineca (ORAR) n'a pas été maintenue ouverte ; par conséquent, aucune surveillance n'était nécessaire pour assurer le passage en toute sécurité des ongulés sortant des routes déneigées. Une politique sur la chasse, la pêche et la cueillette a été mise en œuvre en 2018 pour interdire la pêche, la chasse et le piégeage dans la zone du projet.

Environ 0,30 hectare de végétation a été défriché pour la construction du fossé SP-27. Une étude préalable au défrichement a été réalisée avant l'enlèvement de la végétation le 29 juillet 2022, y compris les zones d'étangs à proximité qui pourraient constituer un habitat approprié pour le crapaud de l'Ouest (Anaxyrus boreas). De même, aucun gîte maternel n'a été découvert pour le petit myotis brun (Myotis lucifugus) ou le myotis à longues oreilles du Nord (Myotis septentrionalis). Aucune tanière d'animaux à fourrure ni aucun nid d'oiseau migrateur n'ont été découverts au cours de l'étude. En outre, aucun décès d'animaux sauvages n'a été signalé en 2022 en raison d'activités liées à la mine, mais deux lagopèdes ont été tués par des renards en raison de leur prédation naturelle.

Lors d'une visite du site, un employé a remarqué une pierre ressemblant à de l'obsidienne et portant les marques d'une sorte d'outil. La pierre a été remise à son emplacement d'origine et le site a été signalé par un tampon et des panneaux de signalisation. La branche archéologique de la Colombie-Britannique et les groupes autochtones locaux ont été informés de la découverte. Cette découverte fortuite a été enregistrée et incluse dans notre rapport annuel sur le patrimoine.

Deux incidents environnementaux se sont produits sur le site de la mine de Kemess en 2022. Le 5 juillet, une inspection de l'IAAC a révélé la présence de taches d'hydrocarbures sur le sol de la ligne directe de l'équipement lourd, une aire de stationnement où les véhicules sont garés. La cause de ces taches a été déterminée comme étant des gouttes d'huile ou de fluide hydraulique provenant de l'équipement lourd stationné. La nature superficielle des taches d'hydrocarbures indique que le volume n'est pas une quantité à déclarer selon le règlement de déclaration des déversements de la loi sur la gestion de l'environnement de la Colombie-Britannique (“BC Environmental Management Act Spill Reporting Regulation”). Sous la direction des inspecteurs, une notification d'accident et de dysfonctionnement a été remplie pour l'incident.

Le 6 juillet, de l'eau s'est déversée d'un trou d'homme et d'un évent d'aération lors d'un déversement de routine dans le ruisseau Attichika. Le déversement a été estimé à 9 mètres cubes d'eau provenant du TSF de KUG, qui s'est accumulée dans un dépôt de gravier et n'a pas eu d'impact sur l'environnement.

Table of Contents

List of Appendices

Appendix A – 2020 Human Health Follow Up Program Plan
Appendix B – 2022 Human Health Follow Up Program Report
Appendix C – Wildlife Sightings at Kemess Mine and on the Omineca Resource Access Road (ORAR)
Appendix D – Accidents and Malfunctions Communication Plan

1. Introduction

AuRico Metals Inc. (AuRico) is a wholly owned subsidiary of Centerra Gold, which operates the Kemess property. The Kemess Mine is located in north-central British Columbia, 430 kilometers northwest of Prince George in the Peace River Regional District. The closest communities to the Project by air are Kwadacha (also known as Fort Ware; 79 km), Tsay Keh (111 km), and Takla Landing (182 km). The Kemess South (KS) complex consists of an open pit mine, a processing mill and various ancillary support facilities, including maintenance shops and housing for 400 full-time employees during operations. The KS mine ceased operations in 2011. The Kemess Underground (KUG) Project is an approved 37,500 tonne per day copper and gold mine with a 17-year mine life. The KUG Project is designed to utilize the existing KS facilities, as well as newly constructed infrastructure. Construction of KUG began in 2018. In 2020, construction of the KUG project was paused and Kemess Mine was put into Care and Maintenance.

AuRico received both a BC provincial Environmental Assessment Certificate (#M17-01) and a Canadian Environmental Ministers Decision Statement in March of 2017. All the various provincial and federal permits required to construct the mine have been received. Initial surface Construction activities began at the Kemess Mine Site on July 6, 2018.

This report has been developed to meet Decision Statement Condition 2.9: "*the Proponent Shall, commending in the reporting year during which the Proponent begins the implementation of the conditions set out in this Decision Statement, prepare an annual report".* The report is laid out such that each heading addresses an annual reporting requirement defined within the subheadings of Condition 2.9.

2. Consideration for consultation

The following sections identify the Decision Statement conditions that required consultation and how the Proponent has considered the views and information received as per the requirements set out in Conditions 2.2 to 2.14.

2.2 The Proponent shall, where consultation is a requirement of a condition set out in this Decision Statement:

> *2.2.1 provide a written notice of the opportunity for the party or parties being consulted to present their views and information on the subject of the consultation;*
>
> *2.2.2 provide sufficient information on the scope and the subject matter of the consultation and a reasonable period of time to permit the party or parties being consulted to prepare their views and information;*
>
> *2.2.3 provide a full and impartial consideration of any views and information presented by the party or parties being consulted on the subject matter of the consultation; and*
>
> *2.2.4 advise in a timely manner the party or parties being consulted on how their views and information have been considered by the Proponent.*

2.3. The Proponent shall, where consultation with Indigenous groups is a requirement of a condition set out in this Decision Statement, communicate with each Indigenous group with respect to the manner by which to satisfy the consultation requirements referred to in condition 2.2, including methods of notification, the type of information and the period of time to be provided when seeking input, the process for full and impartial consideration of any views and information presented on the subject of the consultation, and the means by which Indigenous groups will be informed of how their views and information have been considered by the Proponent.

2.4. The Proponent shall, where a follow-up program is a requirement of a condition set out in this Decision Statement, determine, as part of the development of the follow-up program and in consultation with Indigenous groups and relevant authorities, the following information, for each follow-up program:

> *2.4.1. the methodology, location, frequency, timing, and duration of monitoring associated with the follow-up program as well as the scope, content, and frequency of reporting of the follow-up results;*
>
> *2.4.2. the levels of environmental change relative to established baseline conditions that would require the Proponent to implement additional mitigation measure(s), including instances where the Proponent may require Designated Project activities to be stopped; and*
>
> *2.4.3. the range of technically and economically feasible mitigation measures to be implemented by the Proponent if monitoring conducted as part of the follow-up program shows that the levels of environmental change referred to in condition 2.4.2 have been reached or exceeded.*

2.5. The Proponent shall submit the information referred to in condition 2.4 to the Agency prior to the implementation of a follow-up program. The Proponent shall update that information in consultation with Indigenous groups and relevant authorities during the implementation of the follow-up program, and shall provide the updated information to the Agency, Indigenous groups, and relevant authorities within 30 days of the information being updated.

2.6. The Proponent shall, where a follow-up program is a requirement of a condition set out in this Decision Statement:

2.6.1. conduct the follow-up program according to the information determined pursuant to condition 2.4;

2.6.2. undertake monitoring and analysis to verify the accuracy of the environmental assessment as it pertains to the particular condition and/or to determine the effectiveness of any mitigation measure(s);

2.6.3. determine whether modified or additional mitigation measures are required based on the monitoring and analysis undertaken pursuant to condition 2.6.2; and

2.6.4. if modified or additional mitigation measures are required pursuant to condition 2.6.3, develop and implement the modified or additional mitigation measures in a timely manner and monitor them pursuant to condition 2.6.2.

2.7. Where consultation with Indigenous groups is a requirement of a follow-up program, the Proponent shall discuss with each Indigenous group opportunities for the participation of that Indigenous group in the implementation of the follow-up program, including the analysis of the follow-up results and whether modified or additional mitigation measures are required, as set out in condition 2.6.

2.8. The Proponent shall follow the consultation process outlined in conditions 2.3, 2.4, 2.5, and 2.7 when consulting Gitxsan Wilp Nii Kyap for the purpose of conditions 3.7 and 9.5.

2.9. The Proponent shall, commencing in the reporting year during which the Proponent begins the implementation of the conditions set out in this Decision Statement, prepare an annual report that sets out:

2.9.1. the activities undertaken in the reporting year to comply with each of the conditions set out in this Decision Statement;

2.9.2 how the Proponent complied with condition 2.1;

2.9.3. for conditions set out in this Decision Statement for which consultation is a requirement, how the Proponent considered any views and information that the Proponent received during or as a result of the consultation;

2.9.4. the information referred to in conditions 2.4 and 2.5 for each follow-up program;

2.9.5. the results of the follow-up program requirements identified in conditions 3.7,

4.3, 5.1, 6.10, and 6.11; and

2.9.6. any modified or additional mitigation measures implemented or proposed to be implemented by the Proponent, as determined under condition 2.6.

2.10. The Proponent shall submit to the Agency the annual report referred to in condition 2.9, including an executive summary in both official languages, no later than March 31 following the reporting year to which the annual report applies.

2.11. The Proponent shall publish on the Internet, or any medium which is widely publicly available, the annual reports and the executive summaries referred to in conditions 2.9 and 2.10, the reports related to accidents and malfunctions referred to in conditions 9.4.3 and 9.4.4, the communication plan referred to in condition 9.5, the implementation schedule referred to in condition 10.1, and any update(s) or revision(s) to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available throughout construction and operation and until the end of decommissioning. The Proponent shall notify the Agency, Indigenous groups, and Gitxsan Wilp Nii Kyap of the availability of these documents upon publication.

2.1.2. The Proponent shall notify the Agency and Indigenous groups in writing no later than 60 days after the day on which there is a transfer of ownership, care, control, or management of the Designated Project in whole or in part.

2.1.3. The Proponent shall consult with Indigenous groups prior to initiating any material change(s) to the Designated Project that may result in adverse environmental effects, and shall notify the Agency in writing no later than 60 days prior to initiating the change(s).

2.1.4. In notifying the Agency pursuant to condition 2.13, the Proponent shall provide the Agency with a description of the potential adverse environmental effects of the change(s) to the Designated Project, the measures proposed to be implemented by the Proponent to mitigate adverse environmental effects, and the results of the consultation with Indigenous groups.

3. Condition 3: Fish and Fish Habitat

3.1. Condition 3.1

The Proponent shall implement erosion and sedimentation control measures within the Project are during all phases of the Designated Project to avoid the deposit of deleterious substances in water frequented by fish.

As per the Erosion Prevention and Sediment Control Plan, erosion and sediment control (ESC) techniques were implemented as part of KUG Care and Maintenance activities in 2022. There were ongoing stabilization earthworks performed in the Kemess Lake Valley (KLV) throughout the year, as well as hydroseeding being done in the fall before snowfall and repairs to existing silt fencing. In addition, the bank on the road to the Attichika Creek Diffuser and banks along River Jordan were stabilized and hydro/hand seeded. Furthermore, the overburden stockpile north of the WRD was also stabilized through re-contouring. Elsewhere, routine maintenance on roads, the airstrip and other surfaces were maintained as needed to protect against erosion and subsidence. All water that reports to the mine site water management area (MSWMA) is either pumped to the KUG Tailings Storage Facility (TSF) or flows to sediment settling features (i.e. settling ponds, check-dams) prior to release into the natural environment.

Settlement ponds were successful in reducing sediment transport within the MSWMA, verified by in-situ turbidity measurements at discharge points.

3.2. Condition 3.2

The Proponent shall, taking into consideration Fisheries and Oceans Canada's Measures to Avoid Causing Harm to Fish and Fish Habitat Including Aquatic Species at Risk, implement mitigation measures when conducting Designated Project activities to avoid causing harm to fish and fish habitat, including timing work in or around water to respect the timing windows identified to protect fish.

No in-stream works were conducted during the reporting period. To avoid and mitigate any potential for serious harm to fish, the following measures will be implemented when in-stream works are necessary:

- Works will be completed during the November- February low flow period;
- A qualified environmental professional will be present to monitor for the presence of fish in the immediate construction areas; and
- Riparian clearing will be kept to a minimum.

3.3. Condition 3.3

The Proponent shall comply with the Metal Mining Effluent Regulations and subsection 36(3) of the Fisheries Act regarding the deposit of effluent from the Designated Project in water frequented by fish, taking into account the Canadian Council of Ministers of the Environment's

Water Quality Guidelines for the Protection of Aquatic Life, from the start of construction to the end of decommissioning. In doing so, the Proponent shall:

> *3.3.1 place all acid-generating and potentially acid-generating material into the tailings storage facility and submerge all such materials placed in the tailings storage facility under a permanent water cover; and*

During construction activities at the Kemess Mine site in 2018, all acid-generating and potential acid-generating material was deposited into the KUG TSF under a permanent water cover.

> *3.3.2 collect and treat all waters affected by the Designated Project that do not meet the requirements of the Metal Mining Effluent Regulations and subsection 36(3) of the Fisheries Act, as applicable, prior to the affected waters being deposited in waters frequented by fish.*

Water quality sampling will take place as per the Metal and Diamond Mining Effluent Regulation (MDMER) and the *Fisheries Act,* when production triggers that requirement, and will be conducted in accordance with the Canadian Council of Ministers of the Environment's Water Quality Guidelines for the Protection of Aquatic Life.

Select seepage water from the NAG Waste Rock Dump, which has relatively high selenium concentrations, was originally collected in the Selenium Collection Pond (SeCP). This water was then pumped directly to the KUG TSF through a pump and pipeline system. The Southern Collection System Pond (SCSP), which was completed and commissioned in September 2020, receives flow by gravity from the SeCP via the Southern Collection Ditch (SCD). The SCSP, which allows for a greater quantity of seepage water from the NAG waste rock dump to be captured, including seepage points located to the west (SP7, SP7a), was continually pumped to the KUG TSF in 2022.

In October 2022, the SP27 ditch was constructed to divert additional seepage coming from this area in the Waste Rock Dump to the SCSP for subsequent pumping back to the KUG TSF.

For the selenium monitoring program investigating seepage in and around the Kemess mine footprint, results from 2022 indicate selenium water-borne levels in all environmental compartments of Waste Rock Creek continue within the range of concentrations observed in previous years, but still exceed selenium provincial guidelines at some stations. . In November 2022, new EMA Permit Interim Attainment Schedule guidelines for water quality stations WQ-14ds and WQ-14F in Waste Rock Creek were implemented. Due to a quick freeze-up and low-flow conditions, this led to selenium exceedances at both stations in November and December 2022. Continued monitoring and investigation into further mitigative actions to better understand flow patterns will help elucidate any further steps needed to avoid any exceedances. However, it is important to note that despite some elevated selenium concentrations, there is no evidence of effects on biological communities of Waste Rock Creek.

3.4. Condition 3.4

The Proponent shall install hydraulic plugs in the declines before the underground mine is flooded to direct seepage from the flooded underground mine towards East Cirque Creek.

Construction of the underground has not started, and hydraulic plugs will be implemented at the time of flooding.

3.5. Condition 3.5

The Proponent shall, in a manner that complies with the Metal Mining Effluent Regulations and subsection 36(3) of the Fisheries Act, discharge water from the tailings storage facility into Attichika Creek during construction and the first year of operation such that flow rates downstream of the discharge location are within the range of minimum and maximum flow rates naturally occurring in Attichika Creek, and shall only discharge water into Attichika Creek during open water months.

Discharge into Attichika Creek in 2022 from the tailings storage facility occurred in accordance with the limits and dilution ratios stipulated in EMA Permit 15335 to protect aquatic life. Discharge only occurred during open water months.

3.6. Condition 3.6

The Proponent shall divert all runoff from the East Pit quarry into the tailings storage facility during construction and operation.

Runoff from the East Pit Quarry drainage reports directly into the KUG TSF via existing drainage ditches. Most flow is captured by gravity, and the rest is collected in a ditch that reports to Dump Pond 1, which is then pumped to the KUG TSF. No additional measures or works were implemented in 2022. Monitoring of the drainage pattern from the East Pit Quarry will continue through the construction and operations phases of the mine life in accordance with the Mine Site Water Management Plan.

3.7. Condition 3.7

Discuss consultation activities relative to Condition 3.7: The Proponent shall develop, prior to construction and in consultation with Indigenous groups, Gitxsan Wilp Nii Kyap, and relevant authorities, and implement, from the start of construction to the end of decommissioning, a follow-up program to verify the accuracy of the environmental assessment as it pertains to fish and fish habitat and to determine the effectiveness of mitigation measures referred to in conditions 3.1 to 3.6. As part of the follow-up program, the Proponent shall:

3.7.1 monitor quality of water discharged in Attichika Creek during the dewatering of the Kemess South Pit and treat that water to meet the requirements of subsection 36(3) of the Fisheries Act;

AuRico Metals submitted its permit application to the Major Mines Permitting Office (MMPO) on August 31, 2017. Prior to the official permit application submission, AuRico Metals consulted with Tsay Keh Nay (TKN) on the development of a Fish and Aquatic Effects Monitoring Plan (FAEMP), a Wildlife Management and Monitoring Plan (WMMP), and a Mine Site Water Management Plan (MSWMP); circulating draft copies of these plans on June 30, 2017, which was 60 days in advance of the official permit application submission. These plans were developed in consideration of Condition 3.7. AuRico and TKN continued to consult on management plans throughout the permitting process and established collaboration and consultation methods espoused within the 2017 Impact Benefit Agreement (IBA). Permitting and permitting consultation activities with relevant authorities and TKN for KUG are ongoing.

During the permitting process, TKN, via their consultants at Environment Dynamics Incorporated (EDI), provided feedback on fish and fish habitat. TKN comments focused on the Selenium Management Plan, which outlines selenium monitoring, as well as mitigation measures for capturing flows with elevated selenium and addressing potential flow reduction in Waste Rock Creek. TKN was concerned that reduced flows in Waste Rock Creek may result in the environmental flow needs for fish and fish habitat not being met in Waste Rock Creek. In response, AuRico installed an additional monitoring station (WQ-14ds) in 2018 to gather flow data to verify model flow predictions; data from which is being used to inform management decisions if the environmental flow needs in Waste Rock Creek are not being met.

In 2022, discharge occurred to Attichika Creek between June 8 to August 6. The Attichika Diffuser is shown in photo plate 3.5.1.

Results from the 2022 Fish and Aquatic Effects Monitoring Study showed that condition of water quality, sediment quality, periphyton communities, and benthic invertebrate abundance, composition, and diversity, and fish tissue concentrations in Attichika Creek remained within pre-discharge levels, and were consistent with those of healthy aquatic ecosystems in the region.

3.7.2 monitor surface water quality in Amazay Lake and groundwater movement between the subsidence zone identified by the Proponent during the environmental assessment and Amazay Lake;

A baseline characterization of Amazay Lake and Amazay Creek was conducted in September 2019 to support the Amazay Lake Adaptive Management Biological Monitoring program by providing background data of biological communities at Amazay Lake and Amazay Creek prior to the start of the KUG mine operations. The baseline characterization included water quality, sediment quality, periphyton, benthic invertebrate communities, and fish tissue metal concentrations.

3.7.3 monitor changes in channel form and sediment load downstream of the discharge location in Attichika Creek;

Fish monitoring in Attichika Creek has shown that there is no direct evidence that juvenile fish were avoiding habitats within a short distance downstream from the active diffuser. This reinforces the understanding that channel form and sediment load remain unchanged from previous years.

3.7.4 monitor changes in water quality in Waste Rock Creek and the tailings storage facility, including changes in selenium concentrations;

As mentioned previously, water-borne selenium concentrations remain elevated at most stations in Waste Rock Creek, although are in the range of previous years. However, selenium concentrations were substantively less in the Attichika wetlands relative to upper Waste Rock Creek sampling stations.

3.7.5 monitor the presence and use of spawning habitat by bull trout (Salvelinus confluentus) and rainbow trout (Oncorhynchus mykiss) downstream of the discharge location in Attichika Creek prior to and after the installation of the discharge pipeline into Attichika Creek. The Proponent shall offset any loss of spawning habitat for bull trout (Salvelinus confluentus) and rainbow trout (Oncorhynchus mykiss) in Attichika Creek if monitoring results show that spawning habitat loss has occurred;

Annual fisheries monitoring in 2022 showed that there has not been any loss of spawning habitat for bull and rainbow trout spawning habitat downstream of the discharge location in Attichika Creek.

3.7.6 monitor contaminants, including mercury, in the tissue of fish species harvested by Indigenous groups in Thutade Lake, including bull trout (Salvelinus confluentus)

Bull trout tissue mercury concentrations were greater in 2022, relative to 2019 data, but were similar to 2020 results. Although tissue mercury concentrations have been greater in recent years compared to 2019, previous monitoring programs have reported relatively high mercury concentrations in other local lakes that are not exposed to mine activities, which suggests mercury levels may be naturally elevated in fish communities of the area; particularly in large, piscivorous fish such as Thutade Lake bull trout.

4. Condition 4: Migratory Birds

4.1. Condition 4.1

The Proponent shall carry out Designated Project activities in a manner that protects migratory birds and avoids harming, killing, or disturbing migratory birds or destroying, disturbing, or taking their nests or eggs. In this regard, the Proponent shall take into account Environment and Climate Change Canada's Avoidance Guidelines. The Proponent's actions in applying the Avoidance Guidelines shall be in compliance with the Migratory Birds Convention Act, 1994 and with the Species at Risk Act.

In 2022, the construction of SP27 ditch required the clearing of approximately 0.3 ha of area, of which approximately 0.15 ha had vegetative cover. This area consisted of non-merchantable vegetation, and no merchantable trees were harvested within the clearing area. The vegetation clearing occurred outside of the bird nesting window on August 17th, but a pre-clearing survey was still completed on July 29th, 2022 prior to construction.

Bi-weekly surveys of infrastructure potentially used by barn swallows for nesting during the breeding season were completed . These surveys showed that both barn and tree swallows preferred the Accommodations area for nesting, possibly due to availability of more open-sheltered areas to protect their nests. In comparison, it was noted that tree swallows nested on higher abandoned buildings, where the swallows were able to access old air intakes. Cliff swallows preferred to nest around the Mill area, where the conveyor is located approximately 80 meters from the ground, as it appears that these swallows prefer the high areas on-site to protect their nests from predators.

Please refer to the 2022 Annual Reclamation Report for more information, which has the nest data per location for each swallow type and description of monitoring methods utilized.

4.2. Condition 4.2

The Proponent shall deter migratory birds from accessing the tailings storage facility and seepage ponds until water quality is not harmful to migratory birds.

Use of the KUG TSF and seepage ponds by migratory birds was monitored throughout the 2022 reporting year as part of the on-site wildlife reporting. No instances of birds accessing or inhabiting the KUG TSF or seepage ponds were reported in 2022. Monitoring for use by migratory birds will continue in 2023 and deterrent(s) will be implemented as necessary. Although the water quality of the KUG TSF does not meet chronic aquatic life guidelines for some parameters, it is not considered harmful to migratory birds.

As an additional measure, non-harmful bird deterring mechanisms will be implemented in the spring of 2023 to ensure no migratory bird nesting occurs on KUG-TSF or seepage ponds.

4.3. Condition 4.3

The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to determine the effectiveness of the mitigation measures to avoid harm to migratory birds, their eggs, and nests, including the mitigation measures used to comply with conditions 4.1 and 4.2. The Proponent shall implement the follow-up program from the start of construction to the end of decommissioning.

A follow-up program will be developed and implemented once a decision is made to initiate construction of KUG.

5. Condition 5: Human Health

5.1. Condition 5.1

The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples caused by changes in concentrations of contaminants of potential concern identified during the environmental assessment in air, soil, water, and sediment. The Proponent shall implement the follow-up program during construction and operation. As part of the development of the follow-up program, the Proponent shall:

> *5.1.1 identify levels of environmental change relative to established baseline conditions for contaminants of potential concern that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health; and*
>
> *5.1.2 if monitoring results demonstrate that concentration levels for contaminants of potential concern are greater than the identified levels of environmental change, update the human health risk assessment for the consumption of traditional foods exposed to these contaminants and communicate the results of the updated human health risk assessment to Indigenous groups.*

AuRico Metals circulated the proposed Human Health Follow-up Program to TKN via email on March 20, 2018. A reminder of requests for feedback was discussed at the April 20, 2018 EMC meeting. To date no comments have been received.

As per Section 4.4 of the Human Health Follow-up Program and Section 3.4 of the Ecosystem Management Plan, soil and vegetation sampling was conducted in 2022. Vegetation used by wildlife for forage was targeted, including sedges, lichens, and willows. Soil and vegetation were sampled on-site in different areas exposed to industrial activities, as well as at non-impact

control sites.

The soil and vegetation were analyzed for trace metal uptake. The soil sample results were compared to both CCME and BC Contaminated Site Regulation soil quality guidelines. The vegetation sample results at exposure sites were compared to the non-impact control sites using statistical analyses.

This sampling was conducted to match the frequency of the Reclamation and Closure Plan update, which also occurred in 2022. Detailed results will be presented in the Human Health Follow-up Program report, which will be submitted by 31 March 2023. This report is also included in Appendix B.

6. Condition 6: Current Use of Lands and Resources for Traditional Purposes

6.1. Condition 6.1

The Proponent shall install and maintain, during construction and operation, ramps every 100 to 300 metres over the discharge line between the tailing storage facility and Attichika Creek to provide passage for moose (Alces alces), woodland caribou (Rangifer tarandus caribou), grizzly bear (Ursus arctos), and furbearers. The Proponent shall identify the locations of ramps in consultation with Indigenous groups and relevant authorities.

The discharge line between the KUG TSF and Attichika Creek was installed in 2018. There are no other impediments relating to this condition. As the entire discharge line was buried at the time of installation, wildlife access has never been impeded, thereby removing the need for installation of ramps.

6.2. Condition 6.2

The Proponent shall create and maintain, during construction and operation, escape pathways along all access roads associated with the Designated Project, including the northern section of the Omineca Resource Access Road, to allow ungulates to exit the plowed roads. The Proponent shall identify the locations of escape pathways in consultation with Indigenous groups and relevant authorities.

During all snow-laden months in 2022, the Omineca Resource Access Road (ORAR) was not kept open; therefore, there was no need for monitoring to ensure safe passage of ungulates exiting plowed roads. Additionally, on mine roads snowbank breaks are created every 300 meters adjacent from each other to allow movement of wildlife through the winter months.

In the spring, summer and fall of 2022, a contractor was retained as per the IBA to complete brushing and road maintenance on the ORAR.

6.3. Condition 6.3

The Proponent shall, from the start of construction to the end of decommissioning, remove carrion within 24 hours of its discovery by the Proponent from all access roads associated with the Designated Project, including the northern section of the Omineca Resource Access Road.

No carrion were observed by AuRico staff or contractors in 2022. As per the Wildlife Management and Monitoring Plan (WMMP), Kemess tracked incidental wildlife occurrences on the mine site and also on the ORAR corridor. All wildlife observations by Kemess staff and contractors were communicated to the Kemess environmental department via in-person communication, radio communication, or self-documentation. Employees have always been encouraged to submit photos along with the location, date and time of observation to help

confirm the ID of the species and track movement. As the ORAR was closed during snow-laden months, there were no reports of carrion being observed in 2022. Carrion monitoring and removal will continue through the life of mine to the end of decommissioning.

6.4. Condition 6.4

The Proponent shall prohibit employees and contractors associated with the Designated Project from fishing, hunting, and trapping within the Project Area, unless an employee or a contractor is provided access by the Proponent for traditional purposes or for exercising Aboriginal rights, to the extent that such access is safe.

As per condition 6.4, AuRico created the No Fishing, Hunting and Gathering Policy on June 29, 2018, which is reviewed as part of the new worker mine site orientation. The Kemess Mine Fishing and Hunting Policy (FaHP) is designed to ensure safety of Kemess Mine personnel, contractors and the general public in the Kemess Mine area, as well as for the protection of fish, wildlife and plant resources at the mine site. The policy defines that hunting, fishing or trapping, mushroom, berry picking, or the gathering of plants is not permitted by mine personnel or contractors at the mine site at any time. The policy is communicated to all employees at the Kemess Mine site when undergoing mine site orientation. Supplementary signage is posted around site displaying the policy.

6.5. Condition 6.5

The Proponent shall, prior to construction and in consultation with Indigenous groups and relevant authorities, conduct pre-clearing surveys to identify Western toad (Anaxyrus boreas) breeding habitat, and shall implement measures to mitigate the loss of Western toad (Anaxyrus boreas) breeding habitat caused by the Designated Project.

Prior to the official permit application submission, AuRico Metals consulted with Tsay Keh Nay (TKN) on the development of the WMMP. To date, no comments on the Western Toad pre-clearing surveys have been received. AuRico and TKN continue to consult on management plans and follow up program development through established collaboration and consultation methods espoused within the 2017 IBA.

AuRico, through its joint Environmental Management Committee (EMC) with TKN, discusses plans for any major pre-clearing surveys and the subsequent results with TKN.

A pre-clearing bird, furbearers and amphibian survey was conducted on July 29th, 2022 prior to construction of the SP27 ditch, which did not show any signs of the Western Toad (*Anaxyrus boreas)* or any other species of concern.

6.6. Condition 6.6

The Proponent shall conduct pre-clearing surveys to determine the distribution of little brown

myotis (Myotis lucifugus) and Northern myotis (Myotis septentrionalis), and establish, in consultation with Indigenous groups and relevant authorities, buffer zones around active hibernacula and active roosts.

During the permitting process, TKN, via their consultants at Environment Dynamics Incorporated (EDI), provided feedback on the bat pre-clearing surveys, submitting seven questions. TKN comments focused on the methodology used to identify what species of bat were roosting in the area and which roosting structures or nursery bat boxes were actively used.

AuRico conducted initial bat habitat surveys in November of 2017 to inform the initial offsetting requirements for roosting structures. In April, 2018, pre-clearing surveys were conducted prior to construction initiating in July and thirty-five nursery bat boxes were installed. Installed bat boxes will be subject to ongoing monitoring to determine usage and if active, will assist in identifying active hibernacula and active roosts and establishing buffer zones. During 2020, surveys of the bat boxes showed only one instance of bat activity at these sites.

In 2022, liner was placed under bat boxes to better detect usage during non-hibernating months. There were no observations of guano on the liner in 2022, and there were no incidental observations of bats at the Project. Given the very limited observation of bats using the bat boxes or in undisturbed habitat on the Project Site, it appears that the presence of bats in the Kemess area has been over-rated. Additionally, for two years there has been no further disturbance to potential bat habitat and limited anthropogenic activity on site which would deter bat habitation. In 2023, the need for further mitigation of bat habitat will be assessed to determine next steps in accordance with the Wildlife Management and Monitoring Plan.

6.7. Condition 6.7

The Proponent shall install, prior to construction, and maintain, during construction and operation, roosting structures to offset any loss of little brown myotis (Myotis lucifugus) and Northern myotis (Myotis septentrionalis) roosting habitat.

Once a decision has been made to initiate construction, more roosting structures will be planned and implemented to offset any loss of little brown myotis (*Myotis lucifugus*) and Northern myotis (*Myotis septentrionalis*) roosting habitat.

6.8. Condition 6.8

The Proponent shall develop and implement a follow-up program to monitor the little brown myotis (Myotis lucifugus) and Northern myotis (Myotis septentrionalis) usage of buffer zones and roosting structures to determine the effectiveness of the mitigation measures during construction and operation.

During construction and operation, a follow-up program will be implemented to determine the

effectiveness of mitigation measures involving the use of buffer zones for little brown myotis (*Myotis lucifugus*) and Northern myotis (*Myotis septentrionalis*).

A follow-up program will be implemented to monitor mitigation measures for the little brown and Northern myotis upon initiation of construction activities.

6.9. Condition 6.9

The Proponent shall, in consultation with Indigenous groups, undertake progressive reclamation of the habitats disturbed by the Designated Project. The Proponent shall use native species when undertaking that progressive reclamation.

Upon initiation of construction activities, progressive reclamation of the habitats disturbed by the Project will be planned and conducted.

6.10. Condition 6.10

The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to verify the accuracy of the environmental assessment as it pertains to the presence of hoary marmot (Marmota caligata), white-tailed ptarmigan (Lagopus leucura), and short-eared owl (Asio flammeus) within the subsidence zone identified by the Proponent during the environmental assessment and within a buffer area of 250 metres along the limits of that subsidence zone. The Proponent shall implement the follow-up program during construction and operation.

AuRico Metals submitted its initial draft permit application to the Major Mines Permitting Office (MMPO) on August 31, 2017. Prior to the official permit application submission, AuRico Metals consulted with Tsay Keh Nay (TKN) on the development of the WMMP and circulated a draft copy of the plan for comment and feedback on June 30, 2018, 60 days in advance of the official permit submission. Permitting and permitting consultation activities with relevant authorities and TKN as part of the Mine Review Committee (MRC) for KUG concluded in Q2 2018. To date, no specific feedback has been received on the subsidence zone follow-up program. AuRico and TKN continue to consult on management plans and follow up program development through the permitting process and established collaboration and consultation methods espoused within the 2017 IBA.

As per the WMMP, field surveys need to be conducted in areas deemed important habitat for the hoary marmot, white-tailed ptarmigan and short-eared owl prior to clearing and/or construction activities in the subsidence zone. There was no disturbance in the subsidence zone in 2022.

From January to May, 2022, there were 13 ptarmigan sightings. In November, 2022, there were 14 sightings of white-tailed ptarmigan and 16 of the same species in December, 2022. There were two sightings of marmot during July, 2022 and two sightings of short-eared owls within

April and May, 2022.

6.11. Condition 6.11

The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to verify the accuracy of the environmental assessment as it pertains to the effects of changes caused by the Designated Project to the Chase herd of Southern mountain caribou (Rangifer tarandus caribou) and the Thudade herd of Northern mountain caribou (Rangifer tarandus caribou) on caribou hunting activities for traditional purposes and to determine the effectiveness of the mitigation measures. The Proponent shall implement the follow-up program from the start of construction to the end of decommissioning. As part of the follow-up program, the Proponent shall:

> *6.11.1 monitor, during construction and the first three years of operation, the use by moose (Alces alces), woodland caribou (Rangifer tarandus caribou), grizzly bear (Ursus arctos), and furbearers of the ramps referred to in condition 6.1 and of the escape pathways referred to in condition 6.2; and*
> *6.11.2 monitor mortality of wildlife on all access roads associated with the Designated Project, including the northern section of the Omineca Resource Access Road.*

Follow up programs for conditions 6.11.1 and 6.11.2 are outlined in sections 6.1 and 6.2, respectively.

As part of the on-site monitoring program, all wildlife sightings observed on the mine site are tracked. In addition, there are game cameras set up at Kemess North, KLV, Attichika Diffuser, and above the KUG TSF.

For caribou, bear and moose, there were the following sightings on the Kemess Mine site and on the ORAR in 2022: **April:** 1 moose; **May:** 5 black bear; 1 grizzly bear; 2 moose; 1 caribou; **June:** 13 black bear; 47 grizzly bear; 13 moose; 14 caribou; **July:** 14 black bear; 29 grizzly bear; 11 moose; 11 caribou; **August:** 10 grizzly bear; 6 moose; 12 caribou; **September:** 2 black bear; 5 grizzly bear; **October:** 7 grizzly bear; 2 moose; **November:** 6 moose; **December:** 9 moose.

A graph showing the total number of wildlife sightings on the mine site for 2022 is present in Appendix C.

Mortalities of two ptarmigans were observed due to natural predation by foxes. No other wildlife mortalities were noted.

7. Condition 7: Physical and Cultural Heritage and Structures, Sites, or Things of Historical, Paleontological, or architectural

Significance

7.1. Condition 7.1

The Proponent shall, for any previously unidentified archeological structures, sites, or things of historical, archaeological, paleontological, or architectural significance discovered by the Proponent or brought to the attention of the Proponent by an Indigenous group, Gitxsan Wilp Nii Kyap, or another party during any phase of the Designated Project:

7.1.1 immediately halt work at the location of the discovery;
7.1.2 have a qualified individual conduct an assessment at the location of the discovery;
7.1.3 inform, forthwith, in writing, Indigenous groups and Gitxsan Wilp Nii Kyap of the discovery, and allow for monitoring by Indigenous groups and Gitxsan Wilp Nii Kyap during archeological work; and
7.1.4 comply with all applicable legislative or legal requirements and associated regulations and protocols respecting the discovery, recording, transferring, and safekeeping of previously unidentified archeological structures, sites, or things of historical, archaeological, paleontological, or architectural significance.

In early August 2017, an Archeological Impact Assessment (AIA) of five ancillary development areas to the proposed KUG was conducted to ensure compliance with the Heritage Consultation Act (HCA) prior to any ground altering activities. A total of 70 ha of area was surveyed, 295 tests were excavated, and 15 exposures were inspected. The field crew consisted of Millennia personnel and members of Tsay Keh Dene, Kwadacha, and Takla Lake First Nations.

In 2018, an Archaeological Chance Find Procedure was developed for the Project. It provides a standard operating procedure should heritage sites, not identified during baseline studies, be discovered during Construction or Operations. The Archaeological Chance Find Procedure includes the following steps if personnel suspect archaeological, traditional use, and paleontological materials or human remains are discovered:

- Immediately contact the Environmental Superintendent or Construction Manager to implement a stop work order to reduce/minimize impacts to the site;
- Leave the material in place and protect and/or mark the area around the site, and do not disturb or collect any archaeological, paleontological, heritage materials, or human remains; and
- Report the discovery to their immediate Supervisor.

The General Manager and the Project Archaeologist will also be notified as outlined in the management plan. The Archaeology Branch and local Aboriginal groups/organizations will be advised of the discovery, if necessary. Final mitigation measures will be determined through consultation with the Archaeology Branch.

During a site tour in July 2022, a Kemess Environmental employee noticed a rock that resembled obsidian and had the markings of some kind of tool. The rock was put back in its original location and the site was flagged off with a buffer and signage. The B.C. Archaeological branch and the

local indigenous groups were notified of the find. The incidental finding was reported to the TKN and included within the 2022 Annual Heritage Report.

7.2. Condition 7.2

The Proponent shall not undertake any ground altering activities within 50 metres of the boundaries of archeological sites, unless authorized by relevant authorities.

As per the Heritage Management Plan, all known archaeological sites within 150 m of the Project footprint have been clearly indicated on development maps in relation to the Project footprint components. If construction is occurring within 150 m of a protected heritage site, the site will be flagged or temporarily fenced to serve as a visible barrier. The Kemess Environment Monitor will monitor for archaeological site impacts or situations where construction activities occur less than 50 m from a site. Should impacts be anticipated or found to have occurred within 50 m of an archaeological site, the Project Archaeologist will be contacted to determine if additional mitigation measures are required. Environment Department staff members will be fully briefed on the HMP and resulting mitigation measures.

During construction activities, the preferred mitigation measure for archaeological sites is avoidance.

The clearing and construction of the SP27 ditch at the toe of the Waste Rock Dump did not occur in close proximity to any known archaeological sites, nor were there any chance finds during construction.

8. Condition 8: Independent Environmental Monitor

8.1. Condition 8.1

Prior to the start of construction, the Proponent shall retain the service of an independent environmental monitor, who is a qualified individual as it pertains to environmental monitoring of mining projects in British Columbia, to observe, record, and report on the implementation of the mitigation measures set out in this Decision Statement.

Environmental Dynamics Inc. (EDI) was retained in 2018 as the KUG Mine Site independent environmental monitor (IEM). A formal Terms of Engagement Document was submitted to AuRico by EDI in May, 2022.

EDI (Environmental Dynamics Inc.) was retained as IEM throughout the 2022 reporting period.

8.2. Condition 8.2

The Proponent shall give the independent environmental monitor the authority to stop

Designated Project activities that do not comply with the conditions set out in this Decision Statement.

As per the 2018 IEM Terms of Engagement document, the IEM will have authority for stop work and will keep record of all stop work orders where works are resulting in, or are at imminent risk of, causing material environmental damage, in accordance with the EA Certificate and applicable legislation.

A Stop Work Order may be issued under two circumstances:

- In the event where an environmental incident, or where the completion of works at or in proximity to the location of the incident, has the potential to cause material unauthorized environmental impacts.
- In the event that a lack of compliance with the Certificate conditions, authorizations/permits and management plans has the potential to cause unauthorized adverse material environmental effects and previous communications with the responsible parties have not led reasonable corrective action.

Under both circumstances, the IEM will inform the responsible parties, EAO, IAAC and the Holder of the issue within 24 hours and provide rationale and high-level options/considerations for achieving compliance as soon as possible. A recommendation to lift the stop work order will occur when the IEM is satisfied that the appropriate steps have been taken to ensure compliance.

To date, no stop work orders have been issued by the IEM.

8.3. Condition 8.3

The Proponent shall require the independent environmental monitor to prepare reports that include:

> *8.3.1 a description, including through photo evidence, of the Designated Project activities that occurred and the mitigation measures that were applied during the period covered by the report; and*
> *8.3.2 if any, a description, including through photo evidence, of occurrences of non-compliance related to the implementation of mitigation measures set out in this Decision Statement Page 12 of 14 observed during the period covered by the report, the date of the occurrence(s) of non- compliance, whether Designated Project activities were stopped as a result of non- compliance, how the occurrence(s) of non-compliance was or were corrected by the Proponent, the date that the corrective action(s) was or were completed by the Proponent, or, if any, the status of pending occurrence(s) non-compliance that have not been corrected yet, and a description of any adverse environmental effect(s) associated with the occurrence(s) of non-compliance.*

As per the July 2022 Environmental Monitoring Committee Terms of Reference document, an annual meeting was proposed to occur with the IEM, the Holder, EAO, IAAC, and other Regulators and Aboriginal Groups. This will be aligned with EMC meetings.

At each meeting, the Holder will provide a summary of Project activities since the last meeting and forecasted construction activities. The IEM will provide an update on the following items.

- Review of previous environmental concerns and status; and
- Summary of new environmental non-compliances and incidences, all corrective actions undertaken and successes of those actions.

A summary of compliance will be provided in a yearly report. The IEM will document, through written and photo documentation, any relevant inspections and communications pertaining to any non-compliance within the IEM checklist and the issue tracking log. Non-compliances will be closed out pending corrective action and removed from the issue tracking log in the subsequent report following indication of closure. Corrective actions by the Holder will be documented in the monthly report along with the date of corrective actions, the status of pending occurrences that have not been corrected yet, and a description of any adverse environmental effects associated with the occurrences of non-compliance.

The first IEM inspection occurred July 11-12, 2018.

In 2022, due to Covid-19 travel restrictions preventing the IEM from coming to site, some inspections were done by questionnaire. In total, we received reports in February, May, August, October and December 2022.

In 2022, the IEM accompanied enforcement officers from IACC to the Kemess Mine site during an inspection that occurred on July 4-7, 2022.

The IEM also accompanied the BC EAO to Kemess Mine site for an inspection that occurred on September 27-28, 2022.

8.4. Condition 8.4

The Proponent shall require the independent environmental monitor to retain the reports referred to in condition 8.3 until the end of decommissioning. The Proponent shall require the independent environmental monitor to provide the reports referred to in condition 8.3 to the Agency, Indigenous groups, and relevant federal authorities within 10 days of their production. If occurrence(s) of non-compliance are observed by the independent environmental monitor, the Proponent shall require the independent environmental monitor to report all occurrence(s) of non-compliance directly to the Agency, Indigenous groups, and relevant federal authorities immediately.

AuRico has communicated the requirement for the IEM to retain compliance reports until the

end of decommissioning. The IEM and IEM Support will be tasked with documenting compliance with the Certificate conditions and management plan commitments throughout all Project phases. The IEM will provide information to EAO, IAAC, Ministry Energy and Mines (MEM), Ministry of Environment (ENV), Forests, Lands, Natural Resources Operations & Rural Development (MFLNRORD) and to Aboriginal Groups as directed by EAO and set out in the Decision Statement. The IEM will not provide such information or reports to the Holder in advance of providing such information or reports to the EAO and IAAC. The IEM will submit monthly (or following their site visit) a report to the Holder, the EAO, and IAAC simultaneously via email. Information or reports related to non-compliance will not be submitted to the Holder in advance of providing the information to the EAO and IAAC.

To align with Condition No. 12 of the Provincial EA Certificate related to the Environmental Monitoring Committee (EMC), and item 8.4 of the Decision Statement to provide reports to Indigenous groups, the IEM will submit the monthly (subject to site visit) and end of phase reports to the EMC on behalf of the Holder.

9. Condition 9: Accidents and Malfunctions

9.1. Conditions 9.1, 9.2, 9.3, 9.4

9.1 The Proponent shall take all reasonable measures to prevent accidents and malfunctions that may result in adverse environmental effects.

9.2 The Proponent shall, prior to construction, consult with Indigenous groups and relevant authorities on the measures to be implemented to prevent accidents and malfunctions.

9.3 The Proponent shall, prior to construction and in consultation with Indigenous groups and relevant authorities, develop an emergency response plan in relation to the Designated Project.

9.4 In the event of an accident or malfunction with the potential to cause adverse environmental effects, the Proponent shall implement the emergency response plan referred to in condition 9.3 and shall:

> *9.4.1 notify Indigenous groups, Gitxsan Wilp Nii Kyap, and relevant authorities of the accident or malfunction as soon as possible, and notify the Agency in writing;*
>
> *9.4.2 implement immediate measures to mitigate any adverse environmental effects associated with the accident or malfunction;*
> *9.4.3 submit a written report to the Agency no later than 30 days after the day on which the accident or malfunction took place. The written report shall include:*
>
> > *9.4.3.1 a description of the accident or malfunction and of its adverse environmental effects;*

9.4.3.2 the measures that were taken by the Proponent to mitigate the adverse environmental effects of the accident or malfunction;

9.4.3.3 any views received from Indigenous groups, Gitxsan Wilp Nii Kyap, and relevant authorities with respect to the accident or malfunction, its adverse environmental effects, and measures taken by the Proponent to mitigate adverse environmental effects; Page 13 of 14

9.4.3.4 a description of any residual adverse environmental effects and any modified or additional measures required by the Proponent to mitigate residual adverse environmental effects;

9.4.3.5 details concerning the implementation of the emergency response plan referred to in condition 9.3; and

9.4.4 submit a written report to the Agency, no later than 90 days after the day on which the accident or malfunction took place, on the changes made to avoid a subsequent occurrence of the accident or malfunction, and on the implementation of any modified or additional measures to mitigate and monitor residual adverse environmental effects and to carry out any required progressive reclamation, taking into account the information in the written report submitted pursuant to condition 9.4.3.

AuRico Metals submitted its permit application to the Major Mines Permitting Office (MMPO) on August 31, 2017. Prior to the official permit application submission, AuRico Metals consulted with Tsay Keh Nay (TKN) on the development of the Emergency Response Plan, circulating a draft copy of the plan for comment and feedback on June 30, 2018, which was 60 days in advance of the official permit submission. The Mine Emergency Response Plan (MERP) is developed in consideration to conditions 9.3 and 9.5.

To date, no comments from TKN have been received on the draft Mine Emergency Response Plan or the draft Accidents and Malfunctions Communication Plan.

AuRico and TKN continue to consult on management plans through the permitting process and through established collaboration and consultation methods espoused within the 2017 Impact Benefit Agreement. Permitting and permitting consultation activities with relevant authorities and TKN for KUG is ongoing. The Mine Review Committee is paused until construction is initiated at the mine site for development of KUG.

Regarding Condition 9.5, AuRico circulated the draft Accidents and Malfunctions Communication Plan to Gitxsan Wilp Nii Kyap on December 22, 2017.

On July 5th, an IAAC inspection found some hydrocarbon staining on the ground at the heavy equipment hotline, a laydown area where vehicles are parked. The cause of the staining was

determined to be drips of oil or hydraulic fluid from the parked heavy equipment. The surficial nature of the hydrocarbon staining indicated that the volume was not of a reportable quantity per the BC Environmental Management Act Spill Reporting Regulation. Under the direction of the inspectors, an Accident and Malfunctions Notification was completed for the incident.

9.2. Condition 9.5

The Proponent shall develop and implement a communication plan in consultation with Indigenous groups and Gitxsan Wilp Nii Kyap. The Proponent shall develop the communication plan prior to construction and shall implement and maintain it up to date from the start of construction to the end of decommissioning. The plan shall include:

> *9.5.1 the types of accidents and malfunctions requiring the Proponent to notify the respective Indigenous groups and Gitxsan Wilp Nii Kyap;*
>
> *9.5.2 the manner by which Indigenous groups and Gitxsan Wilp Nii Kyap shall be notified by the Proponent of an accident or malfunction and of any opportunities for the Indigenous groups and Gitxsan Wilp Nii Kyap to assist in the response to the accident or malfunction; and*
>
> *9.5.3 the contact information of the representatives of the Proponent that the Indigenous groups and Gitxsan Wilp Nii Kyap may contact and of the representatives of the respective Indigenous groups and Gitxsan Wilp Nii Kyap to which the Proponent provides notification.*

As per Condition 9.5, the Accidents and Malfunctions Communication Plan was developed in 2018 to guide the co-ordination of communications between the organization and any applicable outside agencies (e.g. regulatory agencies, stakeholders, and the public) in the event of an accident and/or malfunction resulting from the KUG Project.

This plan identifies the types of accidents and malfunctions requiring notification to external stakeholders and the timeframe of notification (including updates subsequent to the initial notification) to each Aboriginal Group community and other users of the area that could be affected by the accident and/or malfunction. The Accidents and Malfunctions Management Plan is present in Appendix D.

10. Closure

Respectfully submitted,

Ryan Trudeau, B.Sc., R.P.Bio

Environmental Coordinator
Kemess Mine
Ryan.Trudeau@Centerragold.com
604-424-8200 x13823

Lucas Krist, B.A.Sc., E.I.T.

Environmental Coordinator
Kemess Mine
Lucas.Krist@Centerragold.com
604-424-8200 x13833

APPENDIX A

2020 Human Health Follow Up Program Plan

KEMESS UNDERGROUND PROJECT

Human Health Follow-up Program

Version: 2.0

Date: June 2020

AuRico Metals Inc.
110 Yonge Street, Suite 601
Toronto, ON
Canada M5C 1T4
T: (416) 216-2780
F: (416) 216-2781

DOCUMENT TRACKING

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Human Health Follow-up Program

TABLE OF CONTENTS

LIST OF FIGURES

GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Agency, the	The Canadian Environmental Assessment Agency
AQMP	Air Quality Monitoring Plan
BC	British Columbia
BC MOE	British Columbia Ministry of Environment & Climate Change Strategy
CCME	Canadian Council of Ministers of the Environment
COPC	Contaminant of potential concern
CSF	Cancer slope factor
EAC	Environmental Assessment Certificate
EDI	Estimated daily intake
EEM	Environmental Effects Monitoring
ELDE	Estimated lifetime daily exposure
EMP	Ecosystem Management Plan
FAEMP	Fish and Aquatic Effects Monitoring Plan
FDMP	Fugitive Dust Monitoring Plan
HHFP	Human health follow-up program
HHRA	Human health risk assessment
HQ	Hazard quotient
IBA	Impact Benefits Agreement
ILCR	Incremental lifetime cancer risk
km	Kilometre
KUG	Kemess Underground Project
MA/EMA	*Mines Act/Environmental Management Act*
ML/ARD	Metal leaching/acid rock drainage

MSWMP	Mine Site Water Management Plan
ORAR	Omineca Resource Access Road
Project, the	The Kemess Underground Project
RPD	Relative percent difference
SeMP	Selenium Management Plan
SOP	Standard operating procedure
TKN	Tse Keh Nay
TRV	Toxicity reference value
TSF	Tailings Storage Facility
ww	Wet weight

1. INTRODUCTION

The Canadian Environmental Assessment Agency (the Agency) conducted an environmental assessment of the Kemess Underground Project (KUG; the Project) pursuant to the *Canadian Environmental Assessment Act, 2012* and *the Memorandum of Understanding between the Canadian Environmental Assessment Agency and the B.C. Environmental Assessment Office on the Substitution of Environmental Assessments* (2013). A positive Decision Statement was issued by the Agency on March 9, 2017, with conditions (CEAA 2017). Condition 5 relates to Human Health:

> ***5.1.*** *The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples caused by changes in concentrations of contaminants of potential concern identified during the environmental assessment in air, soil, water, and sediment. The Proponent shall implement the follow-up program during construction and operation. As part of the development of the follow-up program, the Proponent shall:*
>
> > ***5.1.1.*** *identify levels of environmental change relative to established baseline conditions for contaminants of potential concern that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health; and*
> >
> > ***5.1.2.*** *if monitoring results demonstrate that concentration levels for contaminants of potential concern are greater than the identified levels of environmental change, update the human health risk assessment for the consumption of traditional foods exposed to these contaminants and communicate the results of the updated human health risk assessment to Indigenous groups.*

This document describes the Human Health Follow-up Program (HHFP) to address the above condition.

1.1 PURPOSE AND OBJECTIVES

The purpose of the HHFP is to mitigate potential adverse effects on the health of Indigenous Peoples as a result of the Project. Objectives of the HHFP are to:

1. Enable the Proponent to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples caused by changes in concentrations of contaminants of potential concern (COPCs) identified during the environmental assessment.
2. Identify levels of environmental change relative to established baseline conditions for COPC that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health.

As per Condition 5.1.2, mitigation measures may include an update to the human health risk assessment (HHRA) for the consumption of traditional foods exposed to contaminants exceeding identified levels of environmental change. Thus, a country foods risk assessment is one of the endpoints for the HHFP. Focusing a risk assessment to country foods is justified because food ingestion can be a significant pathway of exposure in humans to contaminants, contaminants can bioaccumulate in the food chain, and animal food (meat or fish) can migrate from high-exposure

locations to traditional hunting/fishing areas distant from Project sites, where exposure pathways to Project-related contaminants in air and water are much less significant.

The HHFP contains the following components:

- a review of the COPCs identified for baseline and Project phases;
- a summary or relevant monitoring commitments contained in other Project monitoring and management plans, specifically:
  - Mine Site Water Management Plan (MSWMP),
  - Fish and Aquatic Effects Monitoring Plan (FAEMP),
  - Selenium Management Plan (SeMP), and
  - Ecosystem Management Plan (EMP);
- a sampling plan for supplemental sampling of environmental media necessary for country foods monitoring that are not covered under other monitoring plans;
- identification of levels of environmental change relative to baseline conditions in media that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health;
- an outline of the country foods risk assessment steps;
- methodology for the derivation of hazard quotients (HQs) and incremental lifetime cancer risks (ILCRs); and
- a data management and reporting framework.

There is limited use of the KUG mine site area by Indigenous peoples and AuRico Metals Inc. (acquired by Centerra Gold Inc.) has agreed to an area of restricted access ("exclusion area") around the mine site through their Impact Benefits Agreement (IBA). The IBA for the Project was established between AuRico Metals Inc. and the Tse Keh Nay (TKN) First Nations in May 2017. The TKN is an alliance of the Takla Lake First Nation, the Tsay Keh Dene Nation, and Kwadacha Nation. Thus, the HHFP is another layer of measures to avoid impacting the health of Indigenous peoples.

1.2 GENERAL APPROACH

As indicated in Condition 5.1, the objective of the HHFP for the Project is to 1) verify the accuracy of the environmental assessment and to 2) identify levels of environmental change at which modified or additional mitigation measure(s), including an update of the country foods risk assessment, to mitigate increased risks to human health may be implemented. The country foods evaluated in the Project's Application for an Environmental Assessment Certificate (EAC Application; AuRico 2016) were:

- berries: crowberry and soapberry (measured COPC tissue concentrations);
- freshwater fish: Bull Trout, Dolly Varden, Whitefish, and Rainbow Trout (measured COPC tissue concentrations);
- moose (COPC tissue concentrations calculated with a food chain model);

- snowshoe hare (COPC tissue concentrations calculated with a food chain model); and
- ruffed grouse (COPC tissue concentrations calculated with a food chain model).

The calculation of COPC tissue concentrations for moose, snowshoe hare, and ruffed grouse using a food chain model (Golder Associates Ltd. 2005) requires the input of measured COPC concentrations in surface water, soil, and diet items (i.e., vegetation). Thus, the environmental media data that would be required for an updated HHRA for country foods includes: surface water, soil, fish tissue, and vegetation tissue (berries for human consumption and vegetation diet items for moose, hare, and grouse) COPC concentrations.

Monitoring of air quality (i.e., dustfall levels and metals in dustfall) is not required for the HHFP as potential COPCs from the Project through atmospheric deposition will be addressed with the monitoring of metal concentrations in soil and vegetation samples. Monitoring of other parameters in air under the HHFP is not required by Condition 5 as criteria air contaminants (CACs), such as NO_2 or particulate matter, were not COPCs in the original EAC Application (i.e., did not meet the criteria to be considered COPCs, see Section 18.5.2.2 of the EAC Application). However, monitoring of some air quality parameters (including NO_2, SO_2, and particulate matter) is included in the Air Quality Monitoring Plan (AQMP; AuRico 2020a) and in the Fugitive Dust Monitoring Plan (FDMP; AuRico 2020c). Results of monitoring under the AQMP will be considered in reporting under the HHFP (Section 8) if exceedances of applicable objectives or standards for these parameters are identified in the AQMP or the FDMP.

Monitoring of relevant environmental media (i.e., surface water, sediment, soil, vegetation, fish tissue) is described in a series of other monitoring and management plans developed for the Project. It is assumed that if there is no change in these environmental media, the quality of country foods will not change and will not require an update to the risk assessment. Therefore, the HHFP relies on commitments and results from the other monitoring plans developed for the Project. Where warranted, the HHFP includes supplemental sampling specifically designed to meet the objectives of the HHFP and needs of a potential future update to the country foods risk assessment. The general adaptive management structure of the HHFP is as follows:

1. Monitoring of surface water, sediment, soil, vegetation, and fish tissues as per the MSWMP, FAEMP, SeMP, and EMP.
2. Should soil or vegetation sampling within the Project footprint under the existing Ecosystem Management Plan indicate increasing COPC concentrations (i.e., above soil metal or vegetation metal concentrations predicted in the EAC Application), additional soil and vegetation samples will be collected from outside of the Project footprint that are accessible to potential country foods consumers (i.e., supplemental sampling).
3. If levels of environmental change (defined in Section 5) are exceeded in environmental media, the combined environmental media sampling results will be used to update the HHRA for country foods and/or will trigger adaptive management actions described in other management plans, such as:
   - alteration of drainage pathways, re-evaluation of the water balance and water quality model, diversion of non-contact water, water treatment options, and re-evaluation of discharge limits (discussed in Sections 5 and 8 of the MSWMP; AuRico 2017c);

- initiation of additional fish and aquatic habitat Adaptive Management Monitoring Programs and control charting using control datasets (discussed in Section 8.3.7 of the FAEMP; AuRico 2017a);
- corrective actions to lower selenium concentrations in the environment (discussed in Section 8 of the SeMP; AuRico 2017d); and
- corrective action or additional control measures to reduce negative effects to soils and vegetation (discussed in Section 6.3.2 of the EMP; AuRico 2020b).

4. The results and uncertainties of the updated HHRA for country foods will be compared to established baseline and predicted Project results to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples and to indicate whether an increased risk to consumers of country foods exists due to Project activities.
5. Adaptive management/mitigation measures will be reviewed and additional measures will be considered if a significant increase in risk to consumers of country foods due to Project activities is identified.

This phased approach will provide an integrated approach with other ongoing monitoring programs within the Project area, maintains monitoring techniques of historical data collection approaches to allow comparability with previous and ongoing sampling in the Project area, and addresses the requirements of federal HHRA guidelines.

1.3 APPLICABLE GUIDANCE

The HHRA methodology is based on Health Canada's guidelines for HHRAs and environmental assessments (Health Canada 2010a, 2010e, 2010d), which were used in the original EAC Application. Health Canada (2007) also provides a management strategy to reduce the risk of unacceptable exposures to mercury from fish consumption, which is also considered.

2. REVIEW OF CONTAMINANTS OF POTENTIAL CONCERN

The EAC Application (AuRico 2016) identified COPCs for human health under established baseline and predicted Project conditions (i.e., the Construction and Operations phases). Specific contaminants were selected as COPCs if they met at least one of the following five screening criteria:

1. The concentration of metals bound to PM_{10} exceeded (or were predicted to exceed) the Texas Commission on Environmental Quality Effects Screening Levels (Texas CEQ 2014) and the Ontario Ministry of the Environment Ambient Air Quality Criteria (Ontario MOE 2012). However, this COPC screening only applies to the inhalation pathway, which is not considered in the HHFP, as it is of lesser significance than the country foods ingestion pathway.
2. The maximum metal concentrations in soil samples considered in the assessment exceeded (or were predicted to exceed) the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for Agricultural Land Use (CCME 2013).

3. The maximum metal concentrations in surface water exceeded (or were predicted to exceed) the British Columbia Ministry of Environment and Climate Change (BC MOE) Water Quality Criteria for the drinking water supply or Health Canada Guidelines for Canadian Drinking Water Quality, whichever guideline was lower (BC MOE 2015; Health Canada 2015). However, this COPC screening only applies to the drinking water pathway, which is not considered in the HHFP, as it is of lesser significance than the country foods ingestion pathway.
4. Fish tissue metal concentrations considered in the assessment exceeded (or were predicted to exceed) the fish tissue residue guidelines for mercury and selenium:
    a. The BC MOE (Beatty and Russo 2014) screening value of 1.83 mg selenium/kg wet weight (ww) for a high fish consumption rate of >220 g/day.
    b. The Health Canada fish tissue consumption guideline of 0.5 mg mercury/kg ww (Health Canada 2013).
5. Metals that have a potential to bioaccumulate in organisms or biomagnify in food webs, such that there could be significant transfer of the metal from soil to plants and subsequently into higher trophic levels even at concentrations lower than guidelines. These metals include: arsenic, cadmium, lead, mercury, nickel, selenium, thallium, and zinc.

The Joint *Mines Act/Environmental Management Act* (MA/EMA) Permit Application (AuRico 2017b) also evaluated potential changes in COPCs for human health due to updates to air and water quality modelling associated with waste discharge authorizations for the Project. However, no new COPCs were identified during the Joint MA/EMA Permit Application process, thus it is not discussed further. The results of the COPC selection process for the EAC Application are summarized in Sections 2.1 to 2.3; however, the discussion is limited to the COPC screening applicable to country foods (e.g., does not discuss results of screening metals bound to PM_{10}).

2.1 CONTAMINANTS OF POTENTIAL CONCERN IDENTIFIED FOR HUMAN HEALTH UNDER BASELINE CONDITIONS IN THE ENVIRONMENTAL ASSESSMENT

No CACs were identified as COPCs in the baseline air quality screening (see Section 4.4.1 and Table 4.4-1 of Appendix 18-A of the EAC Application; AuRico 2016).

The COPCs identified in the baseline soil quality screening (see Section 4.5 and Table 4.5-1 of Appendix 18-A of the EAC Application; AuRico 2016) were: arsenic, barium, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, vanadium, and zinc.

The COPCs identified in the baseline surface water quality screening (see Sections 4.6.1 and 4.6.2, Tables 4.6-1 and 4.6-2 of Appendix 18-A of the EAC Application using drinking water quality guidelines; AuRico 2016) were: dissolved and total aluminum, cadmium, iron, lead, manganese, nitrate, selenium, and sulphate. However, iron was not retained as a COPC as it is an essential element for humans and since environmental exposure to iron from food consumption (the largest source of exposure) is not likely lead to adverse health effects. Furthermore, iron is considered an innocuous substance by Health Canada (2010c).

The COPCs identified in the baseline fish tissue concentrations (see Section 4.7.1.2 and Appendix A of Appendix 18 A of the EAC Application; AuRico 2016) were mercury and selenium.

Thus, with the addition of bioaccumulative contaminants, the COPCs selected for the baseline HHRA included: aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate (water only), selenium, sulphate (water only), thallium, vanadium, and zinc.

2.2 CONTAMINANTS OF POTENTIAL CONCERN IDENTIFIED FOR HUMAN HEALTH UNDER PROJECT-RELATED CONDITIONS IN THE ENVIRONMENTAL ASSESSMENT

No CACs were identified as COPCs during the Construction or Operations phases based on screening of air quality predictions (see Section 3.3.1 and Table 3.3-1 of Appendix 18-B of the EAC Application; AuRico 2016).

The soil quality selection identified the following COPCs during the Construction and Operations phases (see Section 3.4 and Table 3.4-2 of Appendix 18-B of the EAC Application; AuRico 2016): arsenic, barium, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, vanadium, and zinc.

The following non-metal COPCs in surface water were screened in (against Canadian Drinking Water Quality Guidelines) during both the Construction and Operations phases (see Section 3.5.1 and Table 3.5-1 of Appendix 18-B of the EAC Application; AuRico 2016): nitrate and sulphate. The surface water quality COPC screening (against Canadian Drinking Water Quality Guidelines) identified the following metal COPCs during both the Construction and Operations phases (see Section 3.5.2 and Table 3.5-2 of Appendix 18-B of the EAC Application; AuRico 2016): total and dissolved aluminum, cadmium, iron, lead, manganese, and selenium. Consistent with the baseline HHRA (Section 4.8 of Appendix 18-A of the EAC Application; AuRico 2016), iron was not retained as a COPC.

Fish tissue selection identified selenium as a COPC during both the Construction and Operations phases (see Section 3.6.1 and Tables 3.6-1 and 3.6-2 of Appendix 18-B of the EAC Application; AuRico 2016).

Thus, with the addition of bioaccumulative contaminants, the COPCs selected for the Project-related HHRA include: aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate (water only), selenium, sulphate (water only), thallium, vanadium, and zinc. These COPCs are the same as those selected in the baseline HHRA (Appendix 18-A of the EAC Application; AuRico 2016).

There were no COPCs identified from road dust (Section 3.7 of Appendix 18-B of the EAC Application; AuRico 2016).

2.3 OVERALL LIST OF CONTAMINANTS OF POTENTIAL CONCERN IDENTIFIED FOR HUMAN HEALTH

The overall list of COPCs identified for human health during the EAC Application (AuRico 2016) were: **aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate (water only), selenium, sulphate (water only), thallium, vanadium,** and **zinc**. This list of COPCs is proposed for monitoring in environmental media.

3. RELEVANT MONITORING AND MANAGEMENT PLANS

A series of management and monitoring plans have been developed for the Project. Many of these plans outline monitoring commitments relevant to the HHFP objectives. The HHFP relies on the monitoring and associated results from several of the plans, as described below.

3.1 MINE SITE WATER MANAGEMENT PLAN

Section 6.1.2 of the MSWMP (AuRico 2017c) describes the surface water monitoring in the receiving environment that will be conducted for the Project.

Surface water quality monitoring sites and monitoring frequency under the MSWMP (AuRico 2017c) build on monitoring sites identified in the FAEMP (AuRico 2017a) and have been designed to incorporate the monitoring required under existing permits. Further, the components of the monitoring program are intended to provide sufficient spatial and temporal coverage to collect representative data from the most relevant locations (e.g., downstream of the Project) and time periods (e.g., open water or low flow periods). As applicable, sample and data collection for the separate components of the MSWMP and FAEMP will be coordinated to ensure data are cotemporaneous, which reduces the potential for confounding factors in subsequent analyses.

Surface water quality locations monitored during Construction and Operations phases under the MSWMP include 6 of the 14 surface water quality model node locations (i.e., KN-11b, WQ-01, WQ-14F, WQ-17, WQ-18, and Thutade Lake) that were used in the HHRA presented in the EAC Application (see Section 4.6 of Appendix 18-A). Thus, for the HHFP, water quality samples obtained from these six monitoring locations shown on Figure 4-1 can be compared to the baseline and predicted Project water quality presented in the EAC Application and the Joint MA/EMA Permit Application.

Stream water quality samples will be collected monthly (12 times per year) during pre-Construction, Construction, and Operations, except for sampling at the far-field monitoring site (Thutade Lake), which will be sampled quarterly. The timing of quarterly sampling is designed to capture representative periods during winter low-flow conditions, freshet, summer low flow, and the increased stream flows in fall.

3.2 FISH AND AQUATIC EFFECTS MONITORING PLAN

Monitoring of aquatic resources (i.e., fish, periphyton, and benthic invertebrate communities, and sediment quality) under the FAEMP (AuRico 2017a) will begin during the first year of Construction. There are three sampling locations for aquatic resources proposed under the FAEMP (shown in Figure 4-1): EEM-18 (equivalent to WQ-18), ATT-DIS, and EEM-13 (equivalent to WQ-13).

The monitoring program will occur every few years over a seven-year period, with infill years of slightly reduced monitoring requirements. Kemess South aquatic monitoring plans include: the Provincial Environmental Effects Monitoring (EEM) in Kemess Creek; selenium reporting in Waste Rock Creek; long-term fish monitoring in Attichika/Kemess creeks; and the Federal EEM in Kemess Creek. The KUG aquatic monitoring plan includes: discharge monitoring and adaptive management in Attichika Creek, Waste Rock Creek and the Northern Project Area; and the Federal EEM in Attichika Creek.

As described in Section 8.3.7.2 of the FAEMP (AuRico 2017a), surface water quality in Amazay Lake (which is 1 of the 14 surface water quality model node locations used in the HHRA presented in the EAC Application) will be monitored during the early Construction phase. Thus, water quality samples obtained under the Amazay Lake monitoring component of the FAEMP can also be applied in the HHFP.

Fish monitoring studies are described in Section 8.3.5.7 of the FAEMP (AuRico 2017a). As part of the Adult Fish Monitoring Study, annual non-lethal fish tissue monitoring of adfluvial Bull Trout from Thutade Lake will be conducted. This study will monitor contaminants that can bioaccumulate within fish species, including mercury, and focus specifically on Bull Trout in Thutade Lake, given this population's importance as a food source for Indigenous groups in the area. Sampling will be conducted at three locations in Attichika Creek (Thutade Lake Bull Trout migrate up Attichika Creek to reach spawning habitats), similar to baseline studies presented in Hatfield and Bustard (2015). A target of eight fish will be captured by angling and will be sampled non-lethally using dermal tissue punches. Monitoring will be conducted on an ecologically relevant timeline and will match previous baseline sampling and other ongoing monitoring activities to maximize comparability of data over time.

Biological monitoring in Amazay Lake will only be implemented when routine water quality monitoring from the Amazay Lake Monitoring Plan initiates a trigger response (outlined in Section 8.3.7.1 of the FAEMP). In addition, biological sampling is also proposed in Amazay Lake during the early Construction phase years (either fall 2018 or 2019) as an adaptive management approach and to update baseline information for this lake. Proposed sampling includes Rainbow Trout tissue metal analysis because they are the most abundant fish species in the Lake. Thus, if fish tissue sampling is triggered or fish is collected as an adaptive management approach, samples will also be used in the HHFP.

3.3 SELENIUM MANAGEMENT PLAN

Section 6.1.2 of the SeMP (AuRico 2017d) describes the surface water and sediment monitoring in Waste Rock Creek that will be conducted for the Project. Monitoring will be conducted in accordance with permit PE15335, with sample sites and frequencies specified in the permit.

Section 6.5 of the SeMP (AuRico 2017d) describes the proposed fish tissue sampling. A very small population of adult fish is present in Waste Rock Creek; thus, alternate locations such as the Attichika

wetlands will be considered for an annual lethal fish survey. Methodology for fish tissue sampling is provided in the FAEMP (AuRico 2017a). Fish tissue will be analyzed for a full suite of metals.

Surface water quality data, sediment quality data, and fish tissue metal data obtained via monitoring under the SeMP will be used in the HHFP. Should an update of the HHRA for country foods be required, fish tissue monitoring data will be incorporated into the risk assessment for consumers of fish.

3.4 ECOSYSTEM MANAGEMENT PLAN

Sections 5.2.2 and 5.2.3 of the EMP (AuRico 2020b) describes the monitoring for trace metal uptake in soil and vegetation that will be conducted for the Project. Under the EMP, vegetation sampling for metals analysis will be co-located with soil sampling, and vegetation samples will be collected with each soil sample (provided relevant vegetation species are present at the sampling site).

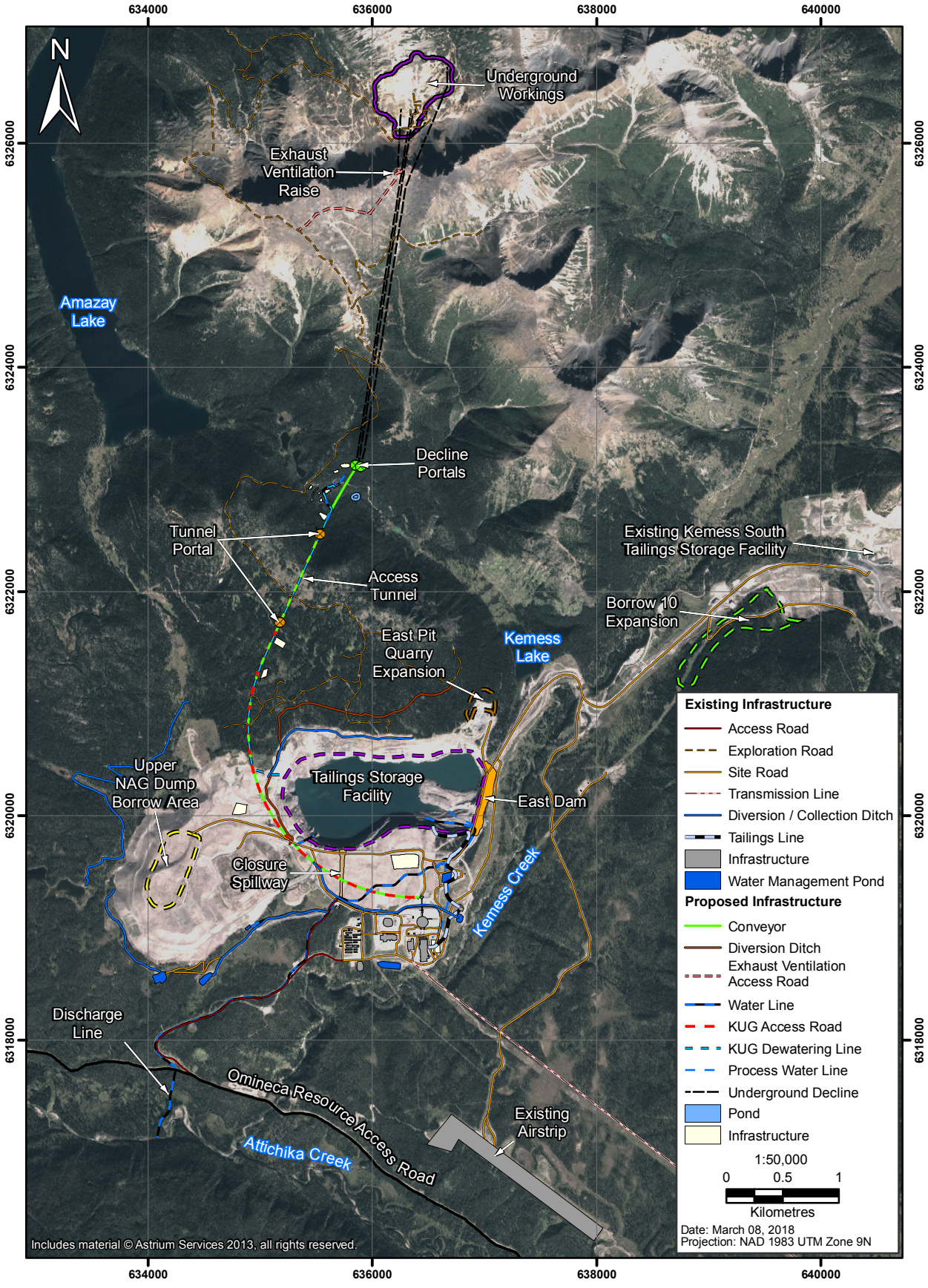
Trace metal concentrations in soil and vegetation will be monitored in samples collected from areas disturbed by the Project (i.e., the Project footprint; Figure 3-1) during the life of mine. Soil and vegetation samples will also be collected from a non-impact control site for comparison. The non-impact control site will be identified at the time of sampling based on accessibility; the preferred location based on air quality modelling is southwest of the mine site, at least 1 km south of the access road.

The frequency of soil and vegetation sampling will be every three to five years to match the frequency of the Reclamation and Closure Plan review/update.

Vegetation sampling will include species identified as country foods and important forage species for wildlife. Vegetation species identified as country foods or important forage species for wildlife include the following:

- Crowberry (*Empetrum nigrum*);
- Soapberry (*Shepherdia canadensis*);
- Water sedge (*Carex aquatilis*);
- Drummond's willow (*Salix drummondiana*);
- Grey-leaved willow (*Salix glauca*);
- Blueberry willow (*Salix myrtillifolia*);
- Tea-leaved willow (*Salix planifolia*);
- Mackenzie's willow (*Salix prolixa*);
- Balsam willow (*Salix pyrifolia*);
- Meadow horsetail (*Equisetum pratense*);
- Marsh cinquefoil (*Comarum palustre*); and
- Fireweed (*Epilobium angustifolium*).

Figure 3-1
Project Footprint



Vegetation samples will be collected in the middle of July, close to the peak summer growth prior to seedset, or at the end of August when berries are ripe. Shrub samples should be collected as a composite from new growth of twigs and leaves from at least three locations on each plant. Sedge and herb samples should be collected as a composite of stems and leaves from each plant. Berries from fruiting shrubs will be collected separately from other plant parts. Composite samples are comprised of clippings from five plants, distributed throughout the sample site, to ensure that the minimum sample weight is collected. Although composite samples have lower variability than individual samples, the results are likely more representative of what would be consumed by browsing wildlife or by humans. Three replicate samples of each composite species should be collected at each sample site.

Soil samples will be analyzed for a comprehensive suite of total metals with detection limits applicable for Agricultural and/or Residential/Parkland use standards. Vegetation samples will be analyzed for a full suite of metals.

4. SAMPLING PLAN

The monitoring locations of environmental media required for the HHFP are shown in Figure 4-1.

4.1 WATER

All of the COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate, selenium, sulphate, thallium, vanadium, and zinc; see Section 3.1) are included in the environmental monitoring programs for water quality under the MSWMP (AuRico 2017c), FAEMP (AuRico 2017a), and SeMP (AuRico 2017d).

Surface water quality monitoring locations that will be used for the HHFP (i.e., KN-11b, WQ-01, WQ-14F, WQ-17, WQ-18, Thutade Lake, and Amazay Lake) are shown on Figure 4-1. The water quality monitoring locations and frequency of monitoring described in the MSWMP (AuRico 2017c), FAEMP (AuRico 2017a), and SeMP (AuRico 2017d) are considered to be sufficient to identify levels of environmental change (described in Section 5.1) for the HHFP. These sites were included in the HHRAs in the EAC Application and are located downstream of the Project in areas where Project-related changes in water quality are most likely to occur, and sampling is already proposed on a regular (monthly or quarterly) basis. Thus, supplemental surface water quality monitoring under the HHFP is not proposed.

4.2 SEDIMENT

All of the COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc), except for those that only apply to surface water, are proposed for monitoring in sediment under the FAEMP and/or other aquatic monitoring programs ongoing in the Kemess Area (Section 3.2).

Sediment quality sampling locations that will be used for the HHFP are shown on Figure 4-1. The monitoring locations and frequency of monitoring for sediment described in the FAEMP (AuRico 2017a) and SeMP (AuRico 2017d) are considered to be sufficient to identify levels of environmental

change (described in Section 5.2) for the HHFP. These locations are downstream of the Project in areas where changes in sediment are most likely to occur and potential changes in sediment concentrations of COPCs typically occur over longer time periods. Thus, supplemental sediment quality monitoring under the HHFP is not proposed.

4.3 FISH

All of the COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc), except for those that only apply to surface water, are proposed for monitoring under the FAEMP Adult Fish Monitoring Study (Section 3.2) and/or the SeMP (Section 3.3).

Exact locations for fish tissue sampling under the SeMP are currently unknown (potential locations include the Attichika wetlands). Fish tissue sampling locations under the FAEMP are shown on Figure 4.-1. The monitoring locations and frequency of monitoring for fish tissue metals described in the FAEMP (AuRico 2017a) and SeMP (AuRico 2017d) are considered sufficient for fish metal characterization for a potential country foods risk assessment. The sampling sites are located downstream of the Project in areas where changes in tissue concentrations are most likely to occur and where fish populations may support ongoing sampling efforts. Thus, supplemental fish tissue sampling under the HHFP is not proposed.

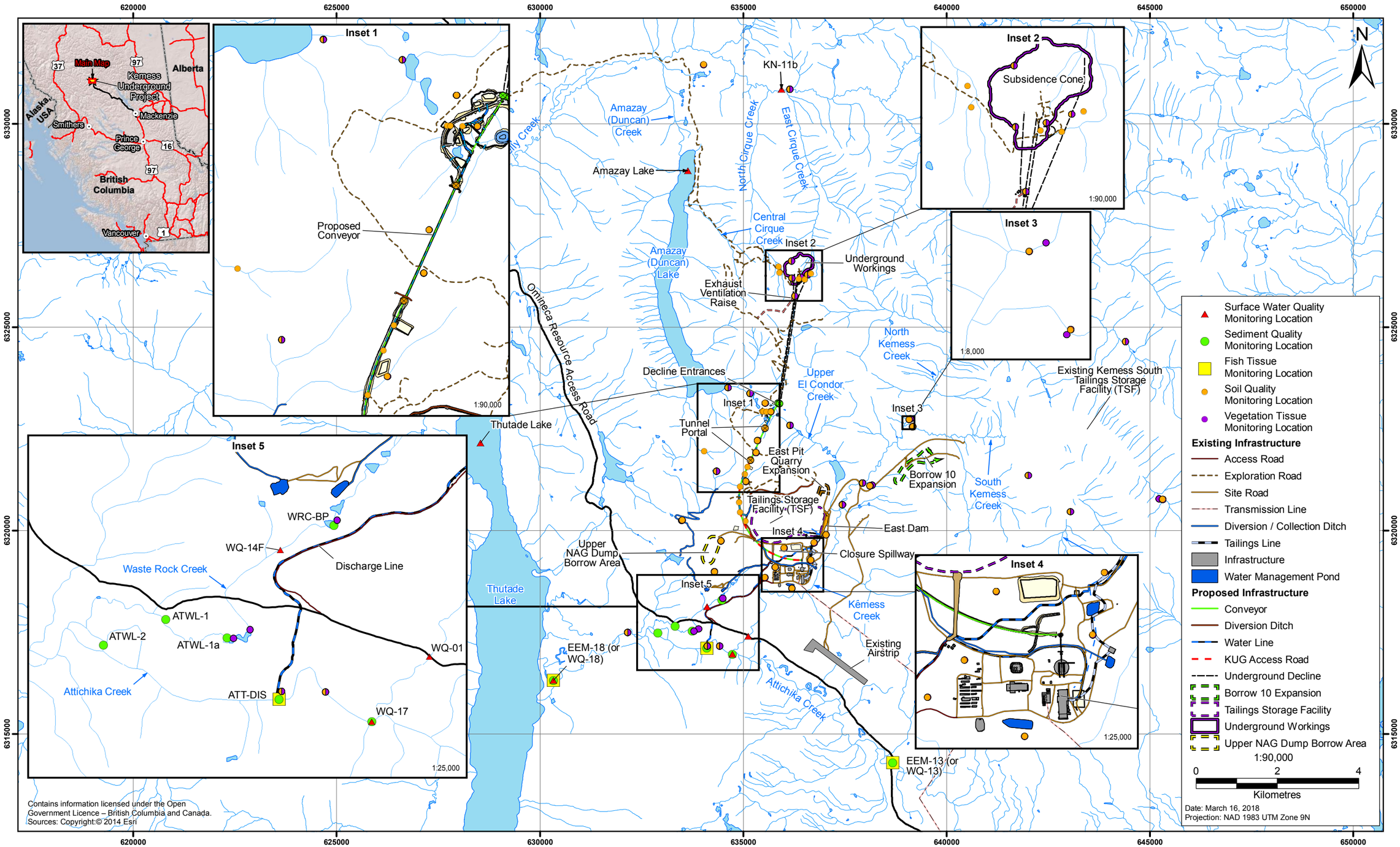
Inclusion of methylmercury analysis may be considered; however, sample volumes may be too small to allow inclusions (i.e., dermal punch samples). In the event that methylmercury analysis cannot be done, it will be assumed that 100% of the mercury measured in fish tissue is in the methylmercury form, consistent with the approach used in Appendix 18-A and 18-B of the EAC Application (AuRico 2016).

4.4 SOIL AND VEGETATION

Soil and vegetation monitoring done under the EMP (Section 3.4 and AuRico 2020b) will be considered in the HHFP. Soil and vegetation sampling sites will be co-located and samples of both soil and vegetation will be collected at the same time at each site (provided relevant vegetation species are present at the sampling site). The COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc), except for those that only apply to surface water, are included in the analysis planned under the EMP.

The sampling locations and frequency (every three to five years) of monitoring for soil and vegetation metal concentrations described in the EMP (Section 3.4 and AuRico 2020b) are considered to be sufficient as a starting point to identify levels of environmental change (described in Section 5.3) for soil and vegetation within the Project footprint. These sites within the Project footprint were selected because they are closest to the Project-derived sources of dust and are in the most likely areas to experience the greatest changes in soil or vegetation metal concentrations. The predicted changes in soil and vegetation metal concentrations during Construction and Operations were small (Table 3.4-2, 4.6-1 and 4.6-2 of Appendix 18-B of the EAC Application; AuRico 2016) and potential changes to soil or vegetation tissue metals were predicted to occur over a long time horizon (e.g., several decades). Therefore, initially sampling every three to five years is considered sufficient for the protection of human health.

Figure 4-1
Environmental Media Monitoring Locations for the Human Health Follow-up Program



However, if sampling under the EMP identifies that COPC concentrations in either soils or vegetation within the Project footprint exceed predicted concentrations plus 30% variance (40% for high variability metals, i.e. aluminum, barium, lead, mercury, and molybdenum, see Section 5.0), the sampling frequency for soil and vegetation will be increased to a minimum of every three years.

In addition, if either soil or vegetation sampling under the EMP indicates this trigger for increased sampling frequency has been exceeded within the Project footprint, supplemental soil and vegetation sampling will be added to the program at locations outside of the Project footprint where baseline soil and vegetation sampling was conducted (shown in Figure 4.5-1 of Appendix 18-A of the EAC Application; AuRico 2016). A subset (~10) of sites outside of the Project footprint that were sampled in baseline soil and vegetation quality monitoring programs would require sampling. Sites will be preferentially selected for supplemental sampling if they are downwind of the Project footprint (where dustfall was predicted to be highest during Construction and Operations such as immediately south of the KUG TSF and around the main Mine Site area) or where soil and vegetation samples were co-collected previously.

The soil and vegetation sampling methodology and laboratory analysis described in Section 5.2.2.2 and 5.2.3.2 of the EMP (AuRico 2020b) will be followed in collecting supplemental soil and vegetation samples for the HHFP.

Priority species for supplemental sampling include country foods (i.e., crowberry and soapberry) and diet species for moose, hare, and grouse assessed in the HHRA in the EAC Application to ensure data comparability with baseline studies. Vegetation species identified as country foods or important forage species for wildlife were identified in Section 3.4. Vegetation sampling will be dependent on the types of species present at each supplemental sampling site. Where possible, multiple vegetation species will be co-collected at each sampling location; however, due to the large number of species sampled under baseline programs, not all baseline species need to be sampled in each year of supplemental sampling.

5. LEVELS OF ENVIRONMENTAL CHANGE

Predicted concentrations of COPCs in water, sediment, soil, and vegetation were used to define the acceptable level of change relative to baseline conditions. The predicted concentrations of COPCs were considered to be acceptable because, in the EAC Application, no residual effects to human health were expected based on this level of incremental change relative to baseline concentrations in environmental media (Chapter 18 and Appendix 18-B).

The BC MOE (2013) has defined no change in surface water quality as a difference of no greater than 20% since laboratory precision for measurement of low concentration metals in replicate samples is typically no better than 20% (quantified as the relative percent difference; RPD) and natural variability is often greater than 20%. Changes in concentration below this threshold are not likely to be measurable or statistically different from each other. Therefore, the trigger level to identify concentrations that are measurably different than those used in the EAC Application is predicted concentrations plus 20%.

The issues with laboratory precision and natural variability also apply to sampling other types of environmental media. Natural matrix variability/heterogeneity is generally higher in soils and

sediments than in water and higher acceptable RPDs on the order of 30 to 40% are reasonable for these media (Austin 2015). Therefore, a magnitude of 30% change relative to predicted concentrations will be applied to sediment, soil, and dustfall monitoring for most COPCs, and a magnitude of 40% will be applied to high variability metal COPCs (i.e., aluminum, barium, lead, mercury, and molybdenum) as identified in Austin (2015).

5.1 WATER

If the results of surface water quality monitoring at the seven surface water quality model nodes (i.e., KN-11b, WQ-01, WQ-14F, WQ-17, WQ-18, Thutade Lake, and Amazay Lake) indicate that COPC concentrations exceed predicted Project concentrations during the Construction or Operations phases (as described in Appendix 11-D of the EAC Application and Appendix 5-G of the Joint MA/EMA Permit Application) plus 20% for at least three consecutive samples (i.e., for a duration of at least three months except for Thutade Lake, which will be sampled quarterly), a HHRA for country foods will be triggered.

5.2 SEDIMENT

If the results of sediment quality monitoring indicate that COPC concentrations in sediment exceed established baseline concentrations (as described in Section 14.4.3.3 of the EAC Application, since sediment quality is not expected to change from baseline conditions due to the Project) by 30% (40% for high variability metals) for at least three consecutive samples (i.e., for at least three years), a HHRA for country foods will be triggered.

5.3 FISH

A country foods risk assessment for fish will only be triggered by increases in COPC concentrations of substances in water and sediments that are known to bioconcentrate or bioaccumulate in fish above levels of environmental change set out in Sections 5.1 and 5.2. Fish tissue COPC concentrations are generally of higher variability than COPC concentrations in other environmental media due to various factors, including smaller sample size, matrix differences, fish age, developmental stage, life history, habitat, and condition factor. Therefore, fish tissue monitoring data obtained as part of the Adult Fish Monitoring Study of the FAEMP and SeMP will not be used to set trigger levels, but rather to update the country foods risk assessment, if required.

5.4 SOIL AND VEGETATION

If the results of soil quality monitoring indicate that COPC concentrations in soil samples exceed predicted concentrations during the Construction or Operations phases (as shown in Table 3.4-2 of Appendix 18-B of the EAC Application) plus 30% (40% for high variability metals) for at least three consecutive samples (i.e., for at least nine years), a HHRA for country foods will be triggered.

If the results of vegetation tissue metals monitoring indicate that COPC concentrations in vegetation samples exceed predicted concentrations during the Construction or Operations phases (as shown in Tables 4.6-1 and 4.6-2 of Appendix 18-B of the EAC Application) plus 30% (40% for high variability metals) for at least three consecutive samples (i.e., for at least nine years), a HHRA for country foods will be triggered.

6. COUNTRY FOODS RISK ASSESSMENT STEPS

Should monitoring results demonstrate that concentration levels for contaminants of potential concern are greater than the identified levels of environmental change (Section 5), the HHRA for the consumption of country foods exposed to these contaminants will be updated. As with the HHRAs conducted in the EAC Application (Appendices 18-A and 18-B), the HHRA for country foods will be divided into the following six steps based on guidance from Health Canada (2007, 2010a, 2010e, 2010d), and considering any updates to guidance as issued from time to time:

1. Problem Formulation: the conceptual model developed for Project conditions for the EAC Application for conducting the HHRA will be updated in the problem formulation stage. The problem formulation will revisit human receptors and human receptor characteristics, identify the COPCs and media that have triggered the HHRA, and describe food chain and exposure routes considered in the assessment (country foods ingestion only).
2. Exposure Assessment: exposure equations, COPC-specific characteristics, receptor assumptions, and the measured (water, soil, sediment, vegetation) or calculated (country food species) COPC concentrations are presented in this section. An exposure dose is calculated to estimate the daily intake of COPCs for human receptors from the consumption of country foods. For country foods where tissue concentrations were not measured during monitoring studies (i.e., moose, snowshoe hare, and ruffed grouse), food chain modelling will be conducted to estimate tissue concentrations. Food chain modelling of COPC uptake into wildlife tissue is generally highly conservative relative to direct measurement and has the potential to overestimate COPC tissue concentrations by orders of magnitude (Health Canada 2010d). This maintains the conservative nature of the HHRA and ensures with a high degree of certainty that risks will not be under-estimated or overlooked (Health Canada 2010d).
3. Toxicity Assessment: the toxicity reference values for the COPCs (TRVs; levels of daily exposure that can be taken into the body without appreciable health risk) are identified.
4. Risk Characterization: HQs are calculated for threshold chemicals (i.e., non-carcinogens) and ILCRs for non-threshold chemicals (i.e., carcinogens). The exposure and effects assessments are integrated by comparing the estimated exposure dose of COPCs from country foods with TRVs to produce quantitative risk estimates (HQs or ILCRs). Exposure via the country foods pathway is compared to a single TRV for each COPC.
5. Uncertainty Analysis and Data Gaps: the assumptions made throughout the HHRA and their effects on the confidence in the conclusions are evaluated.
6. Conclusions: the potential for risk to human health from country foods consumption is described based on the results of the risk characterization, with qualitative consideration of uncertainties and data gaps that might influence the quantitative assessment.

If additional risk assessment guidance from Health Canada becomes available, it will also be considered for use in the HHRA.

7. METHODOLOGY FOR CALCULATING HAZARD QUOTIENTS AND INCREMENTAL LIFETIME CANCER RISK

Using the results of the exposure assessment and TRV assessment (described in Section 6 above), human health risks are quantified using HQs for non-carcinogens and ILCRs for carcinogens. The HQ is the ratio between the estimated exposure dose and the TRV and provides a measure of the potential risk to a receptor for COPCs ingested from country foods. The ILCR is calculated for COPC(s) that may be associated with carcinogenic potential through ingestion of country foods (i.e., arsenic).

7.1 HAZARD QUOTIENTS

The following equation (Health Canada 2010a) is used to estimate the daily exposure dose for each COPC from the total consumption of country foods:

$$Dose_{CF} = \sum \frac{C_{CF_i} \times IR_{CF_i} \times RAF \times DE}{BW} \quad \text{[Equation 1]}$$

where:

- $Dose_{CF}$ = total estimated daily exposure dose of the COPC from country foods ingestion (mg COPC/kg BW/day)
- IR_{CFi} = ingestion rate for country food *i* (kg/day)
- C_{CFi} = concentration of COPC in country food *i* (mg/kg)
- RAF = relative absorption factor from the gastrointestinal tract for the COPC (unitless)
- DE = number of days exposed by consuming country food *i* from the area, per 365 days (days/365 days)
- BW = body weight (kg BW)

The $Dose_{CF}$ of each COPC from country foods ingestion (in mg/kg BW/day) is divided by the COPC-specific TRV (in mg/kg BW/day) to obtain the HQ (unitless) for each COPC, as follows (Health Canada 2010a):

$$HQ = \frac{Dose_{CF}}{TRV} \quad \text{[Equation 2]}$$

where:

- HQ = hazard quotient for the COPC from country foods ingestion (unitless)
- $Dose_{CF}$ = total estimated daily exposure dose of the COPC from country foods ingestion (mg COPC/kg BW/day)
- TRV = toxicity reference value for the COPC (mg COPC/kg BW/day)

For non-carcinogenic COPCs, Health Canada (2010a) suggests that an HQ of less than 0.2 indicates that the exposure does not pose a significant health risk to human receptors. An HQ of 0.2 is used as the benchmark (instead of 1.0) because the assessment does not consider intake of contaminants from all potential exposure routes (e.g., from drinking water ingestion, air inhalation, dermal contact, incidental soil ingestion).

An HQ value greater than 0.2 does not necessarily indicate that adverse health effects will occur since the TRVs are conservative (i.e., protect human health by including additional uncertainty factors) and the assumptions made in the assessment are conservative (e.g., 100% of exposure to country foods comes from within the Human Health LSA).

The results for HQ values and uncertainties for country foods consumption during the assessed monitoring period (i.e., Construction, Operations) will be compared qualitatively to established baseline and predicted Project HQ values.

7.2 INCREMENTAL LIFETIME CANCER RISK

Arsenic is the only potential Project-related COPC that is considered carcinogenic through the ingestion pathway. The following equation is used to calculate the lifetime average daily dose (LADD) from ingestion of arsenic in country foods (Health Canada 2010a):

$$LADD_{CF} = \sum \frac{C_{CF_i} \times IRCF_i \times RAF \times DE \times YE}{BW \times DE \times LE} \quad \text{[Equation 3]}$$

where:

- $LADD_{CF}$ = lifetime average daily dose of arsenic from country foods ingestion (mg/kg BW/day)
- C_{CFi} = concentration of arsenic in country food *i* (mg/kg)
- IR_{CFi} = ingestion rate of country food *i* (kg/day)
- *RAF* = relative absorption factor for arsenic (unitless)
- *DE* = number of days exposed by consuming country food *i* from the area, per 365 days (days/365 days)
- *YE* = number of years exposed by consuming country food *i* from the area (years)
- *BW* = body weight (kg)
- *LE* = life expectancy (years)

Carcinogenic risks due to arsenic exposure are calculated as ILCR estimates according to the following formula (Health Canada 2010a):

$$ILCR = LADD_{CF} \times \text{Oral CSF} \quad \text{[Equation 4]}$$

where:

- *ILCR* = incremental lifetime cancer risk due to arsenic (unitless)
- $LADD_{CF}$ = lifetime average daily dose of arsenic from country foods ingestion (mg/kg BW/day)
- *Oral CSF* = oral cancer slope factor for arsenic $(mg/kg\ BW/day)^{-1}$

The oral cancer slope factor (CSF) for arsenic is 1.80 $(mg/kg\ BW/day)^{-1}$ (Health Canada 2010b). If the calculated ILCR for arsenic ingestion is less than 1×10^{-5}, it is considered to be of negligible risk (Health Canada 2010a).

The results of the ILCR assessment and uncertainties for country foods consumption during the assessed monitoring period (i.e., Construction, Operation) will be compared qualitatively to established baseline and predicted Project ILCR values.

8. DATA MANAGEMENT AND REPORTING FRAMEWORK

Standard operating procedures (SOPs) will be used for environmental data collection, as referenced in the MSWMP, FAEMP, SeMP, and EMP. SOPs will cover all aspects of data collection, data processing, data quality assurance and control (QA/QC), and data management. SOPs will include duplicate sampling, relevant blanks, chain-of-custody procedures, and recordkeeping. The SOPs will be reassessed and updated when necessary, as part of the iterative QA/QC process conducted under the MSWMP (AuRico 2017c), the FAEMP (AuRico 2017a), the SeMP (AuRico 2017d), and the EMP(AuRico 2020b).

AuRico Metals Inc. will assume the responsibility of data management and record-keeping of monitoring results. Data are entered into suitable electronic databases, checked for QA/QC purposes, and stored. Data are entered in a format and program that allow for comparison over time and storage in a single file format for each type of survey or monitoring activity. Monitoring data will be stored for the life of the mine and be made available for review upon request. Designated personnel will coordinate preparation, review, and distribution of the data and reports required for regulatory purposes.

The environmental media data, including COPC concentrations, gathered during monitoring will be presented annually in monitoring reports for surface water, sediments, fish, soil, and vegetation under the MSWMP (described in Section 7.1 of the MSWMP; AuRico 2017c), FAEMP (described in Section 8.3.6 of the FAEMP; AuRico 2017a), SeMP (described in Section 7.1.1 of the SeMP; AuRico 2017d), and EMP (described in Section 6.2 of the EMP; AuRico 2020b).

Annual HHFP reports will be prepared or reviewed by a person with expertise in HHRA. The annual HHFP report will provide the following:

- summary of environmental media COPC monitoring results for surface water, sediments, fish tissues, soils, and vegetation, including any supplemental sampling results (Section 4), and results of CAC monitoring if results indicate exceedance of objectives or standards (Section 1.2; AuRico 2020a, AuRico 2020c);
- comparison of monitoring results to established baseline and predicted COPC concentration data reported in the EAC Application;
- calculated levels of environmental change in environmental media (Section 5) and interpretation;
- identification of any emerging negative environmental trends likely attributable to the Project identified by monitoring and if supplemental monitoring (i.e., increased sampling frequency or collection of additional soils or vegetation samples outside of the Project footprint) has been triggered; and
- description of proposed mitigation measures, revisions to the management plans to address emerging negative trends, or to update the HHRA for country foods, if required.

If the levels of environmental change exceed the levels described in Section 5, then a HHRA for country foods will be triggered following the steps and methodology described in Sections 6 and 7. The results of the updated HHRA for country foods will be communicated to Indigenous groups.

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APPENDIX B

2022 Human Health Follow Up Program Report

Kemess Mine: 2022 Ecosystem Management Plan Soil and Vegetation Sampling and Screening Report

Completed by:
AuRico Metals Inc. - Kemess Mine
Centerra Gold
200 - 299 Victoria Street
Prince George, BC
V2L 5B8

March 2023

EXECUTIVE SUMMARY

AuRico Metals Inc. (AuRico) is a wholly-owned subsidiary of Centerra Gold, which operates the Kemess property. The Kemess Mine is located in north-central British Columbia, 430 kilometers northwest of Prince George in the Peace River Regional District. The closest communities to the Project by air are Kwadacha (also known as Fort Ware; 79 km), Tsay Keh (111 km), and Takla Landing (182 km). The Kemess South (KS) complex consists of an open pit mine, a processing mill and various ancillary support facilities, including maintenance shops and housing for 400 full-time employees during operations. The KS mine ceased operations in 2011. The Kemess Underground (KUG) Project is an approved 37,500 tonne per day copper and gold mine with a 17-year mine life. The KUG Project is designed to utilize the existing KS facilities, as well as newly constructed infrastructure. Construction of KUG began in 2018. In 2020, construction of the KUG project was paused and Kemess Mine was put into Care and Maintenance.

This report presents the results of the Kemess Mine Ecosystem Management Plan (EMP) Soil and Vegetation Sampling and Screening for 2022. Trace metal monitoring of soil and vegetation was conducted at Kemess Mine in 2022 in accordance with the mine's EMP as a basis for assessing whether Project-related activities have resulted in any increases of metal concentrations above applicable Sediment Quality Guidelines (SQGs) for soil, and/or increases in metal concentrations in vegetation relative to earlier baseline conditions. As stipulated in the EMP, this sampling was conducted to match the frequency of updates for the Reclamation and Closure Plan, which also occurred in 2022. The 2022 monitoring study employed a robust sampling approach that incorporated similar sampling methods used during earlier baseline studies but at a greater number of sites (KUG site, KS site, and Omineca Resource Access Road [RD]) and at sufficient replication to allow for statistical assessment of existing data, as well as to adequately compare data collected in 2022 to data collected in the future. The principal conclusions from the 2022 monitoring study are:

- At the KUG site, although soils and lichen samples collected in 2022 showed concentrations of arsenic, copper, lead, molybdenum, selenium, and/or vanadium above applicable SQGs (soil only) and in comparison to reference stations, these results generally reflected background (i.e. non-disturbance, baseline) conditions for the site due to of natural metal-enrichment of soils (and subsequent uptake by vegetation) associated with geological mineralization of the KUG site.
- At the KS site, which has previously been disturbed by historical mining operations, soil samples showed elevated concentrations of copper and molybdenum relative to SQGs. However, concentrations of these and other metals of concern in vegetation did not differ from those at reference sites, indicating no adverse uptake in plants. Although some differences in metal concentrations were observed in lichen tissue between 2022 and previous baseline studies at the KS site, differences in sampling methodology and station locations between 2022 and previous baseline monitoring likely accounted for the variations that were documented between baseline study periods.
- At the RD site, average metal concentrations in soil were below SQGs. Furthermore, no significant differences for metal concentrations in vegetation were found between RD and reference sites in 2022, indicating no Project-related influences on soil and vegetation chemistry at this site to date.

The monitoring design employed in 2022 achieved the EMP objectives set out for evaluating soil quality relative to conservative SQGs, and for evaluating vegetation chemistry relative to baseline samples, while further establishing robust Project-related reference sites and baseline conditions for the Kemess Mine Human Health Follow-up Program (HHFP). Overall, the 2022 data reflect a baseline condition that may serve as the basis for future evaluation of Project-related influences upon further site development. Future monitoring and data assessment under the EMP should include the same sites (KUG, KS, RD, and applicable reference sites), station replication, field sampling procedures, and data analysis methods used in 2022 to provide consistency in Project-related evaluation and tracking of metal concentrations of soil and vegetation for the program.

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AuRico	AuRico Metals Inc.
Centerra	Centerra Gold Inc.
BC	British Columbia
CARO	CARO Analytical Inc.
CEAA	Canadian Environmental Assessment Agency
COC	Chain of Custody
EMP	Ecosystem Management Plan
g dw	Grams dry weight
GPS	Global Positioning System
HHFP	Human Health Follow-Up Program
HHRA	Human Health Risk Assesment
KE	Kemess East
km	Kilometre
KS	Kemess South
KUG	Kemess Underground
m	metre
MDL	Method Detection Limit
EMP	Ecosystem Management Plan
QA / QC	Quality Assurance / Quality Control
REF1	Reference Site 1
REF2	Reference Site 2
REF3	Reference Site 3
SQG	Soil Quality Guideline
the Project	KUG Project

1. Introduction

1.1. Kemess Mine Overview

AuRico Metals Inc. (AuRico), a wholly-owned subsidiary of Centerra Gold Inc. (Centerra), owns the Kemess Mine located in north-central British Columbia, approximately 430 kilometres (km) northwest of Prince George in the Peace River Regional District. The closest communities to the Kemess Mine by air are Kwadacha (also known as Fort Ware; 79 km), Tsay Keh (111 km), and Takla Landing (182 km). The Kemess Mine includes the historical Kemess South (KS) Mine, the Kemess Underground (KUG) deposit, and the Kemess East (KE) deposit. The KS Mine site consists of an open pit gold-copper mine, a processing mill and various ancillary support facilities including maintenance shops and camp accommodations for 400 full-time employees. Due to depletion of mineral reserves, the KS Mine ceased operations and was placed in Care and Maintenance in 2011. The KUG deposit lies approximately 6.5 km north of the existing KS Mine processing mill and supporting infrastructure, the site of which will include a shaft-accessed underground mine and facilities for ore conveyance, electricity supply, and mine dewatering that will connect with existing infrastructure at the KS Mine site in the future.

The Canadian Environmental Assessment Agency (CEAA) conducted an environmental assessment of the Kemess Underground Project (KUG; the Project) pursuant to the Canadian Environmental Assessment Act (2012) and a Memorandum of Understanding between the Agency and the British Columbia (BC) Environmental Assessment Office on the Substitution of Environmental Assessments (2013). The Project includes new construction of infrastructure at the KUG deposit as well as incorporation of historical infrastructure at the KS Mine site. A positive Decision Statement was issued by the CEAA, with conditions, on March 9, 2017 (CEAA 2017), in which the KUG Project was approved as a 37,500 tonne per day copper and gold mine operation with an estimated 17-year mine life. Construction of the KUG Project began in 2018, but was paused and the entire Project put into Care and Maintenance in 2020. To date, very little disturbance has occurred at the area near the KUG deposit, although historically, there has been a substantial amount of mining exploration as well as timber harvesting activities within this area. A map of the Project is shown in Figure 1.1-1.

1.2. Ecosystem Management Plan and Approach in 2022

Under an Ecosystem Management Plan (EMP, May 2018) developed for the KUG Project (Appendix A), trace metal monitoring in soil and vegetation is required to assess whether Project-related activities result in elevation of metal concentrations above applicable Soil Quality Guidelines and baseline conditions, respectively (AuRico, 2018). The frequency of soil and vegetation sampling under the EMP is every three to five years to match the frequency of review/update for the Kemess Mine Reclamation and Closure Plan, which was also conducted in 2022. Over the period from 2003 to 2014, baseline soil and vegetation samples were collected by various consultants within three different locations, including the future KUG site, the existing KS site, and reference sites located north of the Project footprint, and analyzed for pH and/or metal content using accredited laboratories (e.g., ALS, Maxxam Analytics Inc.). These baseline sampling locations and data were reviewed and considered as the basis for the design of this 2022 soil and vegetation chemistry monitoring study, with the objective of meeting EMP Monitoring obligations for investigating potential trace metal uptake in plants (AuRico, 2018).

Soil chemistry samples were collected at the same time and locations as vegetation chemistry samples in 2022. Consistent with the EMP study design, metal concentrations in soil were initially analyzed and evaluated relative to applicable Sediment Quality Guidelines (SQGs). Subsequently, the occurrence of metal concentrations above SQG criteria at sites within the Project footprint prompted further analysis of metal concentrations in vegetation samples.

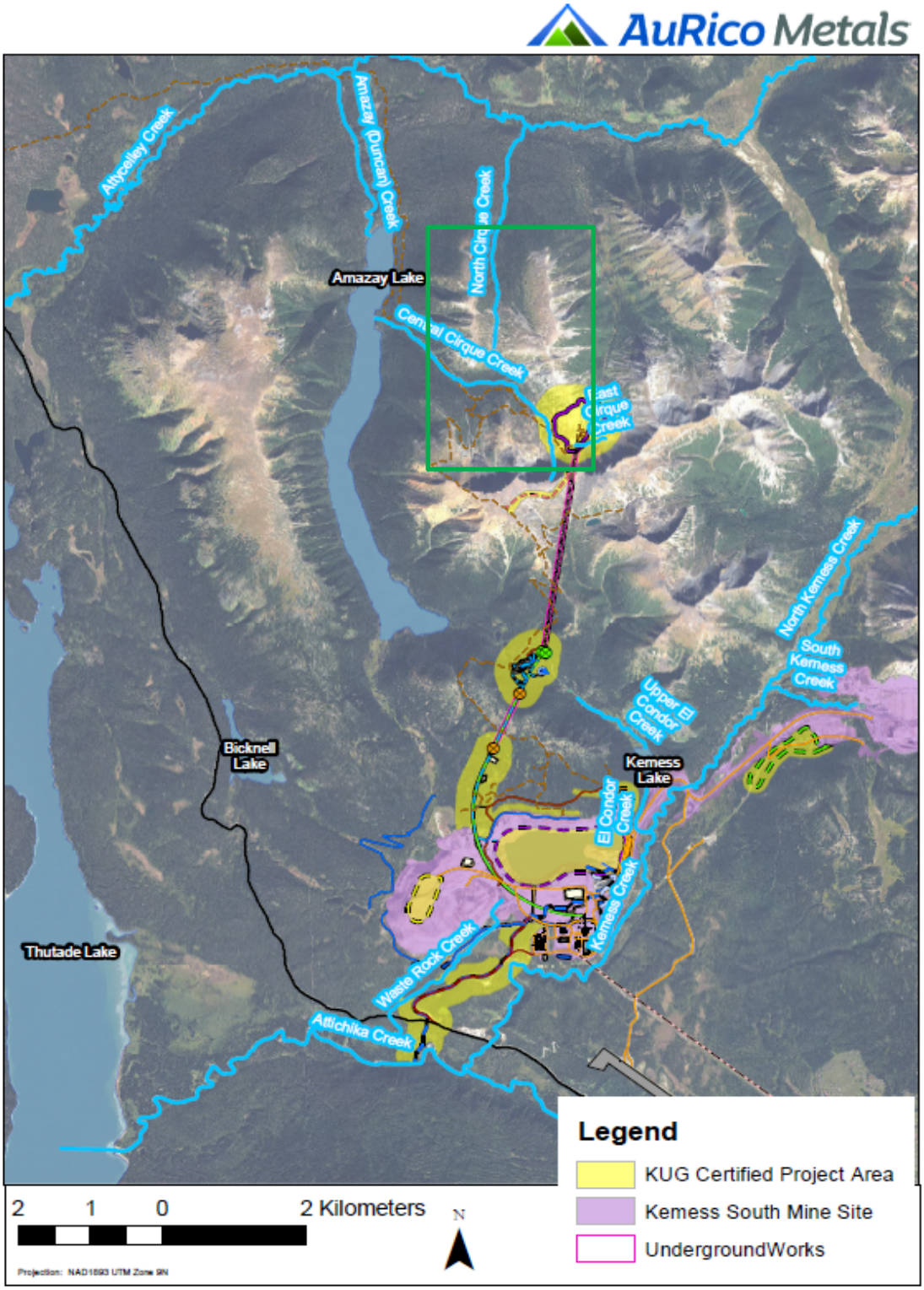

Figure 1.2-1: Kemess Underground Project Location.

Historical baseline data indicated naturally elevated metal concentrations in soil and vegetation, and naturally low soil pH, near the KUG deposit location (Roberts, 2006; Gartner Lee Limited, 2008). As minimal construction activity has occurred at the KUG site (i.e., north of the KS Mine, as indicated by a green box in Figure 1.1-1) to date, soil and vegetation samples collected at the KUG site in 2022 are considered representative of baseline conditions that will be used to evaluate potential Project-related influences in the future, once construction of the Project is completed and operations commence. As per the EMP, the design of the 2022 monitoring study involved a statistical comparison of metal concentrations in vegetation for sites in which metal concentrations in soil were above SQGs. Metal concentrations in soil and vegetation at Project sites in 2022 were also compared to baseline information collected at Project footprint sites from 2003 to 2014 to evaluate potential changes over time.

A Human Health Follow-up Program (HHFP) was developed for the KUG Project (AuRico, 2020; Appendix B) that outlined acceptable levels of change in environmental conditions during Project construction and/or operation phases, as well as thresholds in Section 5 pertaining to changes in conditions during either Project phase that would trigger an assessment of impacts to country foods as part of a Human Health Risk Assessment (HHRA). Specifically, the HHFP states that if soil and vegetation quality monitoring conducted as part of the EMP identified concentrations of contaminants of potential concern (COPCs), including arsenic, barium, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, vanadium, and zinc, that exceed established baseline concentrations by at least 30% during construction or operation phases for at least three consecutive three-year sampling cycles (i.e., nine years), a HHRA for country foods is triggered. Furthermore, the HHFP states that if no changes in concentrations of COPC occur in environmental media such as soil and vegetation over the course of Project construction and/or operation, the quality of country foods is unlikely to have changed, and thus a HHRA is not required. Although the KUG Project is currently in Care and Maintenance (neither in construction nor operation), soil and vegetation samples collected in 2022 in accordance with the EMP were assessed relative to the potential triggers for an HHRA country foods assessment. Consequently, this provided additional insight regarding the suitability of these triggers in relation to the 2022 baseline data and the evaluation of changes in environmental quality at the Project sites over time.

2. Methodology

2.1. Sampling Locations

In summer 2022, soil and vegetation chemistry sampling was conducted at the following locations:

- The Kemess Underground (KUG) site, including three separate study areas within the site;
- The Kemess South (KS) site, including four separate study areas within the site;
- The Omineca Resource Access Road (RD) site, including one study area adjacent to the Attichika Wetland near the planned Project footprint, and two other study areas farther afield; and,
- Three representative reference sites (REF1, REF2, REF3), situated away from the aforementioned Project sites.

Sampling sites are illustrated in Figures 2.1-1 and 2.1-2. To the extent possible, historical locations used for baseline monitoring were incorporated into the 2022 monitoring study to provide temporal continuity among studies. As only one of the historical baseline sampling locations met internal criteria as a reference site (REF1, near water monitoring Station KN-11b), two additional reference sites (REF2 and REF3) were established during the 2022 field study as representative background locations for soil and vegetation chemistry sampling, while also considering safe accessibility for personnel conducting the sampling. The reference sites were situated at locations considered upwind of (based on prevailing winds) and/or at higher elevation or up-gradient of existing or future site infrastructure to ensure minimal Project-related disturbances on soils or vegetation (e.g., dust from TSF and road sources, runoff).

The same types of vegetation were targeted for sampling at all sites and replicate stations to allow for the direct comparison of metal concentrations in vegetation among the Project footprint study sites. Vegetation type was therefore used as a key criterion in selecting the locations of soil and vegetation monitoring replicate stations at each site. The type of vegetation selected for sampling considered plant species listed as candidates in the EMP (Section 5.2.3.2), coupled with empirical observations of the vegetative community at each site and replicate station at the time of sampling in 2022.

Within each site, three to four study areas were established at least 500 metres (m) apart from one another taking into consideration similar vegetation and soil features (e.g., KUG1, KUG2, KUG3). Within each study area, three to five replicate stations were established within an approximate 200 to 300 m radius and at least 150 m apart from one another (e.g., KUG1a, KUG1b, KUG1c). In addition to individual replicates, composite samples for soil and vegetation were taken for each study area reflecting a subsample from all replicate station locations within the study area. Final replicate station locations were selected by technicians in the field in accordance with the above criteria during the 2022 field sampling campaign. Replicate station Global Positioning System (GPS) coordinates are provided in Appendix C.

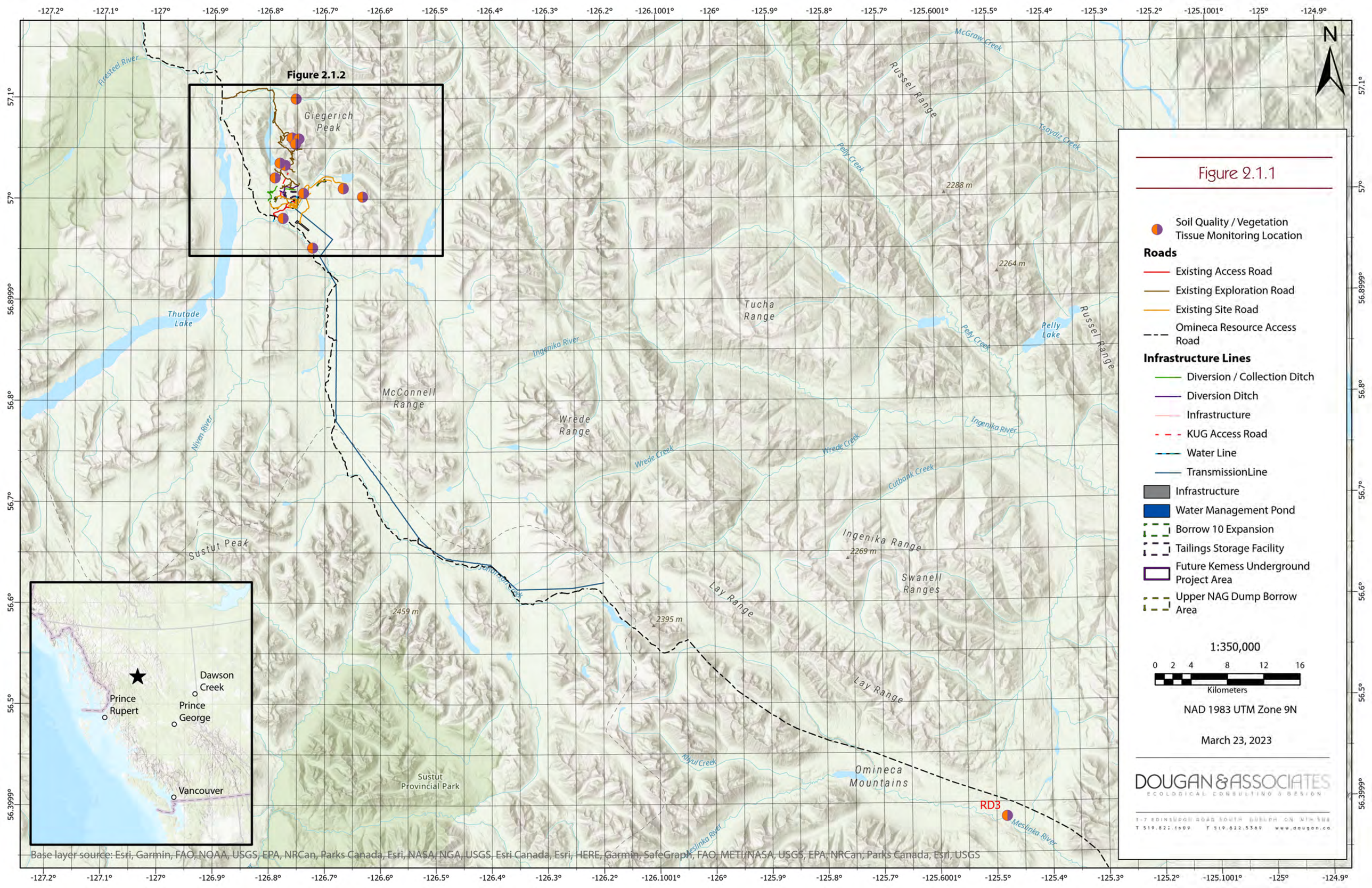
Figure 2.1.2
Giegerich Peak
Firesteel River
Thutade Lake
Niven River
McConnell Range
Ingenika River
Tucha Range
Russel Range
McGraw Creek
Tsaydiz Creek
Pelly Creek
2288 m
2264 m
Pelly Lake
Wrede Range
Wrede Creek
Cutbank Creek
Ingenika Range
2269 m
Swanell Ranges
Lay Range
2459 m
2395 m
Sustut Peak
Sustut Provincial Park
Omineca Mountains
RD3
Mesilinka River
Khyul Creek
Dawson Creek
Prince Rupert
Prince George
Vancouver
N
Figure 2.1.1
Soil Quality / Vegetation Tissue Monitoring Location
Roads
Existing Access Road
Existing Exploration Road
Existing Site Road
Omineca Resource Access Road
Infrastructure Lines
Diversion / Collection Ditch
Diversion Ditch
Infrastructure
KUG Access Road
Water Line
TransmissionLine
Infrastructure
Water Management Pond
Borrow 10 Expansion
Tailings Storage Facility
Future Kemess Underground Project Area
Upper NAG Dump Borrow Area
1:350,000
0 2 4 8 12 16
Kilometers
NAD 1983 UTM Zone 9N
March 23, 2023
DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
3-7 EDINBURGH ROAD SOUTH GUELPH ON N1H 5N8
T 519.822.1609 F 519.822.5389 www.dougan.ca
Base layer source: Esri, Garmin, FAO, NOAA, USGS, EPA, NRCan, Parks Canada, Esri, NASA, NGA, USGS, Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NRCan, Parks Canada, Esri, USGS

REF1
KUG 2
KUG 1
KUG3
KS1
KS2
KS3
KS4
REF 3
REF 2
RD1
RD2
Amazay Lake
Thutade Lake
Bicknell Lake
Attichika Creek
Kemess North Creek
Kemess South Creek
Kemess Tailings Storage Facility

N

Figure 2.1.2

Soil Quality / Vegetation Tissue Monitoring Location

Roads
- Existing Access Road
- Existing Exploration Road
- Existing Site Road
- Omineca Resource Access Road

Infrastructure Lines
- Diversion / Collection Ditch
- Diversion Ditch
- Infrastructure
- KUG Access Road
- Water Line
- TransmissionLine

Infrastructure
- Water Management Pond
- Borrow 10 Expansion
- Tailings Storage Facility
- Future Kemess Underground Project Area
- Upper NAG Dump Borrow Area

1:70,000

0 2 4
Kilometers

NAD 1983 UTM Zone 9N

March 23, 2023

DOUGAN & ASSOCIATES
ECOLOGICAL CONSULTING & DESIGN
3-7 EDINBURGH ROAD SOUTH GUELPH ON N1H 1E8
T 519.822.1609 F 519.822.5589 www.dougan.ca

2.2. Trace Metals in Soil: Sample Collection and Laboratory Analysis

Soil chemistry samples were collected as described in the EMP (AuRico, 2018) for discrete replicate station (soil pit) locations and as a collective composite for each study area. At each separate soil pit replicate station, the overlying layer of coarse organic layer (e.g., leaves, humic material) was removed using a stainless-steel spoon and discarded. Upon removal of the organic material layer, three small subsample 'scoops' of soil were collected from the soil pit to a maximum depth of 30 centimetres (cm) below the surface. The subsampled material was placed into a sieve containing a 2 millimetre (mm) diameter mesh, sifted to remove large debris and gravel, and the sifted material then transferred into a pre-labelled sealable glass jar for the individual replicate station sample. Upon collection of all replicate station samples at each study area, a small ½ scoop of material was taken from each replicate station sample and placed into a separate pre-labelled composite glass jar for the study area. The composite sample was thoroughly blended by shaking the jar by hand following the collection of material from all replicate locations to ensure a homogenous mixture of material.

Decontamination (i.e., cleaning to prevent cross-contamination) of soil sampling equipment (i.e., stainless steel spoons, sieves) was conducted at the beginning of each day and following sampling at each replicate station. The cleaning procedure involved:

- Rinsing the sampling implements with clean water to remove any remaining sediment or organic matter.
- Scrubbing the sampling implements with brushes previously dipped in a Liquinox detergent solution (or a suitable equivalent).
- A final rinse with clean water.

Following collection, the replicate soil samples were placed on ice in coolers when in the field and later into a refrigerator for storage until shipment to the analytical laboratory. Upon completion of the field study, all soil samples were shipped on ice, along with completed chain of custody (COC) records, to CARO Analytical Services (CARO; Richmond, BC). Laboratory analysis of the soil samples included pH and total metals determination using standard laboratory methods. Quality control/quality assurance (QA/QC) for the soil chemistry analyses followed standard laboratory protocols.

2.3. Trace Metals in Vegetation: Sample Collection and Laboratory Analysis

Vegetation samples were collected for trace metal analysis as described in the EMP (AuRico, 2018) at each discrete replicate station location and as a collective composite for each study area concurrent with, and at the same approximate locations, as the soil chemistry sampling locations illustrated in Figures 2.1-1 and 2.1-2. Vegetation samples were collected within an approximately 30 m radius from the center of the soil pit at each replicate station location.

The vegetation types targeted for the analysis were considered dominant vegetation types identified during baseline studies, which suggested that sedges (*Carex* sp.), fireweed (*Chamaenerion angustifolium*), willowherb (*Epilobium* sp.), and willow (*Salix* sp.) species may be widely geographically distributed and considered important forage for various wildlife in the local study region. In 2022, vegetation types encountered most frequently among the Project footprint sites included lichen, sedges, and red willow (*Cornus* sp.), whereas at the reference sites, in addition to lichen and sedges, fireweed and unidentified berries were more commonly present while red willow was absent. The collection of vegetation samples varied depending on the type of vegetation, as follows:

Lichen: Lichen samples were collected from sites that were considered potential feeding grounds for woodland caribou (*Rangifer tarandus*). Lichen samples were hand-removed from the soil, cleaned of needles and other debris as much as possible, and placed into plastic sealable sample bags. Although a mix of lichen genera was generally collected among all replicate stations, the dominant types collected included foliose lichens (*Stereocaulon* spp.) and reindeer lichen (*Cladina* spp.). As the laboratory required a minimum of approximately 10 grams dry weight (g dw) of sample, the collection of separate samples of foliose and reindeer lichen was possible at the reference sites, whereas at Project footprint sites only mixed lichen samples were able to be collected.

Sedge: Sedges were collected within at replicate stations by randomly selecting and grabbing/pulling the plant leaves by hand, which periodically resulted in the inclusion of root material. If roots were collected, the root mass was gently shaken to remove soil material prior to placement into sample bags to reflect material potentially consumed by wildlife (e.g., ungulates). Sampling was conducted randomly, with samples being placed into pre-labelled plastic sealable sample bags until approximately 10 g dw of material was collected for each replicate sample.

Shrubs (Willow) and Herbs (Fireweed): Shrub samples were collected as a combination of new growth of twigs and leaves from at least three locations on each plant. For herb samples, the newest growth and stalks (excluding roots) were collected. Sampling was conducted randomly, placing the samples into pre-labelled plastic sealable sample bags, until approximately 10 g dw of material was collected for each replicate sample.

Berries: Berries from plants such as crowberry (*Empetrum nigrum*) and soapberry (*Shepherdia canadensis*) were collected only if they were determined to be in a ripened stage. If present, approximately two cups (i.e. 500 mL) of berries were picked at each replicate location and placed into pre-labelled plastic sealable collection bags.

For the composite samples, each vegetation type from a study area was collected by adding approximately equal amounts of material into a pre-labelled composite sample bag from each replicate station proportionate to the number of replicates sampled at the study area, with the total volume of material collected deemed sufficient to meet minimum sample weights required by the analytical laboratory (i.e. approximately 10 g dw). The composite sample was thoroughly blended by shaking the sample bag by hand following the collection of material from all replicate stations within the study area to ensure a homogenous mixture of material. All vegetation chemistry samples were collected using 950 millilitre (mL) plastic sealable bags that allowed for ease of sample collection and prevention of sample destruction and mixing during transport. Sample bags were labelled with the following information: client name, sample date and time, sample identification, GPS coordinates, sample type, and initials of field staff. Sample identification reflected the same information as described above for soil samples.

During the field sampling program, sampling records and observations including field staff, photo descriptions, date and time, weather conditions, sample identifications, tissue and soil sample characteristics, number of samples taken, sample locations (including GPS coordinates), sampling duration, and general observations were collected in a field notebook, which included completion of a Ground Inspection Form at each replicate location. Sampling was conducted using nitrile gloves, with a set of new gloves worn between each soil and vegetation sample replicate.

Following return from the field on the day of collection, the vegetation chemistry samples were placed into a freezer and archived. Upon reception and review of the soil chemistry data received from the analytical laboratory, it was then determined that vegetation chemistry analyses were required in accordance with conditions stipulated within the EMP. At that point, the vegetation samples were shipped on ice, along with completed COC records, to CARO for laboratory analysis of moisture content and total metal concentrations using standard laboratory methods. Quality control/quality assurance for the vegetation chemistry analyses followed standard laboratory protocols.

2.4. Data Analysis

2.4.1. Soil Samples

As outlined in the EMP (AuRico, 2018), the soil chemistry data for each replicate station sampled in 2022 were tabulated and evaluated relative to applicable SQGs. As a conservative screening measure, the SQGs used for this evaluation represented the lowest applicable value for each element among the following:

- Canadian Environmental Quality Guidelines (CCME, 2017) Soil Quality Guidelines for Agricultural Purposes,
- British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants,
- British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, and

- British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3).

Comparison of the soil chemistry data to the lowest available SQG ensured that the highest level of conservatism was applied to the screening of data. Average concentrations for each individual parameter (i.e., pH or metal) were calculated for each site, and then compared to the most conservative (i.e., lowest) SQG. Metal concentrations that were below laboratory method detection limits (MDL) in individual replicate station soil samples were substituted with the respective MDL for the calculation of averages and use in any subsequent statistical analyses.

Baseline soil chemistry studies had been previously conducted at KUG and KS sites in 2003 and 2014 (Ardea 2015), thereby allowing temporal comparisons of metal concentrations in soil between 2022 and these baseline studies. However, as replicate station locations within each of these Project footprint sites differed between 2022 and previous baseline studies, direct comparisons of station data were not possible. Rather, the temporal comparisons focused on evaluation of mean (dry weight) metal concentrations in soil for each site between the 2022 and 2003/2014 baseline studies and relative to SQGs. Comparison of data based on dry weight metal concentrations ensured a consistent basis for comparison, and in the event that soil chemistry results did not specify dry weight or wet weight concentrations, the data were omitted from the analysis. No soil chemistry data were collected during baseline studies in 2003 and 2014 from the RD site nor the reference sites used in 2022, which precluded temporal analysis of data for these sites.

2.4.2. Vegetation Samples

Statistical analysis of the vegetation chemistry data was conducted by initially tabulating the 2022 data by vegetation type for each study site. Qualitative comparison of parameter concentrations by vegetation type was conducted within and among Project footprint and reference sites to evaluate the potential for differences in trace metal uptake among vegetation types. Metal concentrations that were below laboratory MDL in individual replicate vegetation chemistry samples were substituted with the respective MDL for the calculation of averages and for use in subsequent statistical analyses.

Metals occurring at average concentrations above respective SQG at any of the Project footprint sites (i.e., KUG, KS, and/or RD) were subsequently used for statistical comparisons of the vegetation chemistry data. The statistical analyses were conducted to assess for differences in vegetation chemistry between the Project footprint sites and the reference sites and thereby provide insight as to whether metals elevated above SQG translated to elevated metal concentrations in plant tissue for each site. The vegetation chemistry data were pooled for each Project footprint site and among the reference sites for the statistical tests. The statistical analyses were conducted separately for the lichen and sedge data, reflecting suitable replication at the Project footprint and reference sites for these vegetation types. A two-sample F-test was initially applied to the data to test for homogeneity of variance (assessed at a p-value of 0.05), after which a two-sample Student's t-test was conducted assuming equal or unequal variance, as applicable. Significant differences for the Student's t-tests were assessed based on a p-value of 0.1 as recommended for environmental effects monitoring (Environment Canada 2012), considering the level of replication achieved (i.e., sample size [n] greater than five at all sites). Significant differences for the Student's t-tests involving sedge were assessed based on a p-value of 0.05 to reflect a lower level of replication used for this vegetation type at the reference sites (i.e. n of three). Because suitable replication for fireweed chemistry was absent at Project footprint sites and red willow data were not collected at the reference sites, no statistical tests were conducted for these vegetation types. Foliose and reindeer lichen chemistry data collected at the reference sites in 2022 were pooled for subsequent comparisons to lichen chemistry samples from the Project footprint sites only after Student's t-tests showed no significant differences in concentrations of metals of potential concern between these two lichen types for the pooled reference sites.

Following statistical comparison of the vegetation chemistry data collected in 2022 between the Project footprint sites and reference sites, the 2022 vegetation chemistry data were compared to baseline data collected in 2007 and 2014 to evaluate potential differences in vegetation metal uptake over time at the Project footprint sites. Vegetation chemistry comparisons between data collected in 2022 and earlier baseline studies were conducted separately for each Project footprint site and vegetation type for each of individual key metals of potential concern (i.e., arsenic, copper, lead, molybdenum, selenium, and vanadium), as the data allowed. The comparisons were conducted on dry weight

concentrations of metals, converted from wet weight concentration data when necessary using laboratory percent moisture information for each individual sample or, in the event that percent moisture data was not available for an individual sample, using the mean percent moisture by vegetation type for the applicable Project footprint site in that study year. The data available for the Project footprint areas from the 2022 and baseline studies allowed the following paired data sets to be compared:

- Lichen chemistry data for KUG based on 2022 and baseline sample sizes of 11 and 7, respectively (baseline data collected in 2014, Ardea 2015);
- Sedge chemistry data for KUG based on 2022 and baseline sample sizes of 5 and 7, respectively (baseline data collected in 2007 and 2014, Ardea 2015); and,
- Shrub chemistry data for KS based on 2022 and baseline sample sizes of 12 and 26, respectively (baseline data collected in 2014; Ardea 2015).

With few exceptions, replicate sampling locations at each Project footprint site differed between the 2022 and baseline studies for the KUG and KS site. For each of the KUG and KS sites, the replicate station data were nevertheless pooled separately for each study period to facilitate temporal comparisons. Accordingly, caution is warranted in the interpretation of results from the temporal analysis conducted herein based on the potential for natural spatial differences in vegetation chemistry within the individual Project footprint sites, due to inconsistent sampling station locations between the 2022 and baseline studies. Similarly, although the same parts of vegetation were sampled (i.e., distal twigs and leaves), the shrub species sampled at KS in 2022 (i.e., red willow) differed from those sampled during baseline studies (a combination of Barclay's, Barratt's, Drummond's, glaucous, tea-leaved, and undergreen willows), leading to some uncertainty in the comparison of results between the 2022 and previous baseline data for shrub vegetation chemistry. No vegetation chemistry data were collected during baseline studies from the RD Project footprint site nor the reference sites sampled in 2022, which precluded a temporal analysis of vegetation chemistry data for these sites.

For each of the individual key metals of potential concern, comparisons between Project footprint site data collected in 2022 and baseline for each vegetation type were conducted using the same statistical F-test and Student's t-test analyses described previously. Additional statistical analysis was conducted on vegetation chemistry data collected at the reference sites in 2022 compared to data collected at the individual Project footprint sites during baseline to provide insight into potential differences shown between the 2022 and baseline studies at individual Project footprint sites.

3. Results

3.1. Trace Metals in Soil

3.1.1. Screening Results

The soil chemistry data for each site in 2022 were tabulated and evaluated relative to the applicable SQGs, the results of which are presented in Table 3.1. At the KUG site, the mean pH of soil was acidic and mean concentrations of arsenic, copper, lead, molybdenum, selenium, and vanadium in soil were above applicable SQGs. At the KS site, mean concentrations of only copper and molybdenum were above the respective SQGs, whereas at the RD site, concentrations of all applicable metals were below the SQGs in 2022 (Table 3.1).

3.1.2. Temporal Comparisons

Temporal comparison of soil chemistry data collected at the KUG site indicated the same metals, including arsenic, copper, molybdenum, selenium, and vanadium, occurred at mean concentrations that were above applicable SQGs in soil for both the 2022 baseline and 2014 (Ardea 2015) baseline studies (Table 3.2). At the KS site, while mean concentrations of arsenic, copper, selenium, and vanadium were all above SQGs in site soil at the time of the 2014 baseline study, only mean concentrations of copper and molybdenum in site soil were above SQGs in 2022 (Table 3.2). The temporal differences in the occurrence of metal concentrations in soil above SQGs at the KS site between the 2022 and 2014 baseline studies may partly be due to changes in replicate station locations between these two studies. Nevertheless, the occurrence of mean concentrations of arsenic, copper, molybdenum, selenium, and vanadium above SQGs in soils at KUG and KS sites in the 2014 baseline study indicated pre-existing high concentrations of these metals in soils within the Project footprint sites relative to the SQGs, which for the KUG site was unrelated to mine construction/activities that started in 2018. Furthermore, as very limited development has occurred at the KUG site to date, the soil metals and pH screening results for 2022 (and historically, in 2014) represent pre-development, baseline conditions for the KUG Project.

Table 3.1: Average pH and metal concentrations of soil samples collected at Kemess Underground, Kemess South, Road, and Reference sites in 2022.

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Site			
				Reference	Kemess Underground	Kemess South	Road
				(15 stations)	(13 stations)	(12 stations)	(9 stations)
pH	pH unit	0.1	na	4.94	5.04	5.41	5.46
Aluminum	mg/kg dw	40	na	22,340	30,192	22,333	19,578
Antimony [e]	mg/kg dw	0.1	15	0.42	1.07	0.52	0.49
Arsenic [d]	mg/kg dw	0.3	10	6.59	19.40	7.93	9.23
Barium [c]	mg/kg dw	1	350	115	87	119	133
Beryllium [d]	mg/kg dw	0.1	1	0.38	0.35	0.64	0.35
Bismuth	mg/kg dw	0.1	na	0.24	2.85	0.53	0.10
Boron [b]	mg/kg dw	2	2	3.1	2.0	3.5	4.2
Cadmium [d]	mg/kg dw	0.04	1	0.390	0.702	0.677	0.458
Calcium	mg/kg dw	100	na	4,050	2,595	6,024	7,469
Chromium [d]	mg/kg dw	1	60	28.7	30.0	32.2	45.0
Cobalt [c,d]	mg/kg dw	0.1	25	9.2	13.8	16.6	14.2
Copper [b]	mg/kg dw	0.4	63	39.4	142.2	111.7	39.0
Iron	mg/kg dw	20	na	40,813	49,869	35,783	33,989
Lead [b]	mg/kg dw	0.2	70	9.2	74.2	10.6	5.0
Lithium	mg/kg dw	0.1	na	11.4	9.4	16.6	11.4
Magnesium	mg/kg dw	10	na	6,935	13,738	8,601	8,600
Manganese [c]	mg/kg dw	0.4	2,000	607	822	636	866
Mercury [b]	mg/kg dw	0.04	6.6	0.044	0.057	0.040	0.042
Molybdenum [b]	mg/kg dw	0.1	5	2.93	22.59	9.63	1.12
Nickel [b]	mg/kg dw	0.6	45	15.3	12.6	23.0	31.0
Phosphorus	mg/kg dw	10	na	718	1,208	631	661
Potassium	mg/kg dw	40	na	1,285	831	663	631
Selenium [b,d]	mg/kg dw	0.2	1	0.44	3.95	0.57	0.49
Silver [e]	mg/kg dw	0.1	15	0.21	0.94	0.20	0.13
Sodium	mg/kg dw	50	na	90	87	118	155
Strontium	mg/kg dw	0.2	na	42.8	42.6	52.1	53.1
Sulfur	mg/kg dw	1,000	na	1,021	1,304	1,000	1,000
Tellurium	mg/kg dw	0.1	na	0.16	2.14	0.35	0.10
Thallium [b]	mg/kg dw	0.1	1	0.11	0.14	0.10	0.10
Thorium	mg/kg dw	0.5	na	0.97	0.68	1.10	1.19
Tin [b]	mg/kg dw	0.2	5	0.77	0.85	0.56	0.35
Titanium	mg/kg dw	1	na	619	552	663	875
Tungsten	mg/kg dw	0.2	na	0.22	0.22	0.24	0.21
Uranium [b]	mg/kg dw	0.05	23	0.87	0.56	1.04	0.90
Vanadium [c]	mg/kg dw	1	100	82.1	102.4	86.2	91.0
Zinc [d]	mg/kg dw	2	150	69.2	129.5	104.6	87.4
Zirconium	mg/kg dw	2	na	3.2	2.9	2.2	2.3

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Table 3.2: Temporal Comparison of average soil chemistry data between 2022 and baseline studies conducted at KUG and KS sites.

Parameter	Units	Soil Quality Guideline [a]	KUG Site		KS Site	
			2014 Baseline (n = 35)	2022 (n = 13)	2014 Baseline (n = 16)	2022 (n = 12)
Soluble pH	pH	na	5.60	5.09	6.25	5.41
Aluminum	mg/kg dw	na	26,933	30,847	27,954	22,333
Antimony	mg/kg dw	15	0.97	1.12	0.85	0.52
Arsenic	mg/kg dw	10	13.04	19.27	10.73	7.93
Barium	mg/kg dw	350	270	92	187	119
Beryllium	mg/kg dw	1	0.93	0.38	1.02	0.64
Bismuth	mg/kg dw	na	0.52	2.73	0.18	0.53
Cadmium	mg/kg dw	1	0.961	0.717	0.593	0.677
Calcium	mg/kg dw	na	9,583	2,586	12,118	6,024
Chromium	mg/kg dw	60	28.6	31.8	65.2	32.2
Cobalt	mg/kg dw	25	12.9	17.0	17.4	16.6
Copper	mg/kg dw	63	102.5	144.0	76.3	111.7
Iron	mg/kg dw	na	44,553	50,878	48,941	35,783
Lead	mg/kg dw	70	15.5	69.0	8.9	10.6
Lithium	mg/kg dw	na	18.7	10.0	17.6	16.6
Magnesium	mg/kg dw	na	10,854	13,670	12,772	8,601
Manganese	mg/kg dw	2,000	1,088	931	781	636
Mercury	mg/kg dw	6.6	0.146	0.056	0.515	0.040
Molybdenum	mg/kg dw	5	10.95	19.93	2.89	9.63
Nickel	mg/kg dw	45	18.1	14.2	38.6	23.0
Phosphorus	mg/kg dw	na	958	1,202	835	631
Potassium	mg/kg dw	na	1,025	800	808	663
Selenium	mg/kg dw	1	3.27	3.55	3.75	0.57
Silver	mg/kg dw	15	0.61	0.90	0.28	0.20
Sodium	mg/kg dw	na	427	89	216	118
Strontium	mg/kg dw	na	91.4	42.7	94.0	52.1
Thallium	mg/kg dw	1	0.15	0.13	0.15	0.10
Tin	mg/kg dw	5	0.96	0.81	0.66	0.56
Titanium	mg/kg dw	na	771	615	1,262	663
Uranium	mg/kg dw	23	1.14	0.55	1.69	1.04
Vanadium	mg/kg dw	100	105.8	104.6	144.9	86.2
Zinc	mg/kg dw	150	111.4	134.0	92.4	104.6
Zirconium	mg/kg dw	na	3.5	2.9	5.0	2.2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

3.2. Trace Metals in Vegetation

3.2.1. Spatial Comparisons

Mean concentrations of arsenic, copper, lead, molybdenum, selenium, and/or vanadium above SQGs in soils at one or more sites within the Project footprint (Table 3.1) triggered the analytical evaluation of the vegetation chemistry samples collected in 2022. Among the four vegetation types sampled in 2022 at Project footprint and reference sites, concentrations of arsenic and vanadium were consistently highest in lichen tissues, while molybdenum concentrations were consistently highest in sedge tissues (Table 3.3). However, no consistent vegetation-specific patterns were apparent for copper, lead, or selenium concentrations among the vegetation types sampled at Project footprint sites in 2022 (Table 3.3).

Table 3.3: Average Dry weight and metal concentrations of vegetation sampled at the KUG, KS, RD and Reference sites in 2022.

Parameter	Units	Reference Sites				KUG Site			KS Site			RD Site		
		Lichen	Sedge	Fireweed	Berries	Lichen	Sedge	Fireweed	Lichen	Sedge	Red Willow	Lichen	Sedge	Red Willow
		(n = 26)	(n = 3)	(n = 7)	(n = 3)	(n = 11)	(n = 5)	(n = 1)	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 9)	(n = 9)
Dry Weight	%	37.2	33.9	15.9	23.7	51.6	38.3	22.7	19.9	25.4	36.2	29.0	38.4	36.4
Aluminum	mg/kg dw	523	42	35	164	933	796	1,640	932	170	48	2,332	289	97
Antimony	mg/kg dw	0.0208	0.0109	0.0093	0.0094	0.0607	0.0283	0.0088	0.0768	0.0180	0.0121	0.0415	0.0181	0.0107
Arsenic	mg/kg dw	0.1411	0.0270	0.0232	0.0507	0.5393	0.3474	0.0870	0.9303	0.1449	0.0440	0.5059	0.0948	0.0402
Barium	mg/kg dw	25.3	22.1	7.7	34.1	35.2	41.0	50.1	61.9	43.6	42.1	51.7	48.8	47.1
Beryllium	mg/kg dw	0.0175	0.0108	0.0093	0.0469	0.0211	0.0238	0.1610	0.0320	0.0114	0.0125	0.0482	0.0129	0.0103
Bismuth	mg/kg dw	0.100	0.108	0.093	0.093	0.130	0.107	0.088	0.107	0.095	0.095	0.094	0.099	0.103
Boron	mg/kg dw	1.09	8.17	2.66	15.92	1.04	2.81	10.20	4.49	5.13	16.96	4.81	4.56	13.45
Cadmium	mg/kg dw	0.133	0.125	0.018	0.093	0.361	0.663	5.050	1.011	0.357	2.873	0.433	0.283	2.891
Calcium	mg/kg dw	2,104	7,450	889	17,100	2,067	4,220	57,700	9,334	5,153	15,345	7,781	5,138	16,444
Chromium	mg/kg dw	0.986	0.435	0.047	0.666	0.964	1.550	0.047	1.514	0.928	0.216	17.490	8.721	10.553
Cobalt	mg/kg dw	0.349	0.050	0.023	0.174	0.883	2.122	13.800	0.774	0.236	2.011	1.682	0.324	1.914
Copper	mg/kg dw	5.78	4.63	3.96	8.32	7.69	11.55	91.50	14.43	6.95	6.30	9.76	6.04	7.57
Iron	mg/kg dw	439	73	20	199	1,296	1,148	216	1,175	255	77	3,292	403	169
Lead	mg/kg dw	0.464	0.037	0.019	0.085	1.910	0.816	2.870	0.567	0.108	0.060	0.571	0.700	0.036
Magnesium	mg/kg dw	558	989	440	3,706	706	864	4,600	1,547	839	2,073	2,431	1,195	3,801
Manganese	mg/kg dw	312	106	151	136	121	573	1,170	439	878	169	439	812	192
Mercury	mg/kg dw	0.063	0.012	0.010	0.022	0.059	0.019	0.015	0.045	0.017	0.011	0.037	0.017	0.013
Molybdenum	mg/kg dw	0.205	2.263	0.079	2.381	0.624	0.814	0.166	1.656	2.706	0.759	0.890	1.237	0.441
Nickel	mg/kg dw	1.076	0.283	0.313	1.084	0.912	2.121	3.000	1.397	0.822	1.702	4.492	2.169	4.273
Phosphorus	mg/kg dw	965	893	897	1,610	879	793	2,270	1,245	1,147	1,509	1,284	1,483	2,664
Potassium	mg/kg dw	3,452	14,300	7,413	10,799	3,576	7,898	13,300	5,058	9,558	8,539	3,570	10,769	9,158
Selenium	mg/kg dw	0.100	0.149	0.093	0.093	0.158	0.141	0.088	0.176	0.105	0.115	0.223	0.248	0.289
Silver	mg/kg dw	0.052	0.054	0.047	0.047	0.087	0.096	0.044	0.158	0.048	0.048	0.092	0.050	0.052
Sodium	mg/kg dw	21.1	29.1	27.8	44.4	21.9	21.4	56.8	29.8	23.5	14.4	32.0	11.9	12.5
Strontium	mg/kg dw	7.8	36.3	1.7	51.0	13.2	24.5	96.3	35.3	18.6	64.0	30.4	20.2	64.3
Thallium	mg/kg dw	0.0134	0.0054	0.0047	0.0047	0.0096	0.0130	0.0044	0.0091	0.0055	0.0048	0.0090	0.0056	0.0056
Tin	mg/kg dw	0.175	0.108	0.093	0.194	0.101	0.105	0.088	0.120	0.122	0.097	0.121	0.113	0.131
Titanium	mg/kg dw	17.89	1.55	0.30	5.00	33.77	23.41	2.20	34.11	10.08	1.66	140.20	17.60	6.68
Uranium	mg/kg dw	0.0119	0.0277	0.0047	0.0059	0.0147	0.0191	0.0044	0.0480	0.0090	0.0049	0.0568	0.0107	0.0058
Vanadium	mg/kg dw	0.952	0.134	0.093	0.291	2.337	1.890	0.180	2.710	0.560	0.113	9.218	0.942	0.347
Zinc	mg/kg dw	27.5	28.3	7.0	29.1	37.1	59.1	405.0	61.4	41.8	129.3	46.6	33.0	157.3

Lichen and sedge vegetation were collected at all three Project footprint sites (i.e., KUG, KS, and RD) and at all three reference sites which allowed direct comparisons of the tissue chemistry data separately for each vegetation type. At the KUG site, concentrations of arsenic, copper, lead, molybdenum, selenium, and vanadium that were higher than SQGs in soil were also significantly higher in lichen tissues from the KUG site compared to the reference sites, except for copper (Table 3.4). However, no significant differences in concentrations of any of these six metals occurred in sedge tissue between the KUG site and the reference sites (Table 3.5).

At the KS site, lichen tissue showed no significant differences in concentrations of arsenic, lead, selenium, and vanadium compared to the reference sites (Table 3.4). In addition, none of these six key metals were shown to occur at significantly higher concentrations in sedge tissue between the KS site and the pooled reference sites (Table 3.5). At the RD site, molybdenum concentrations in lichen tissue were significantly higher than at the reference sites (Table 3.4), despite mean molybdenum concentrations in soil at the RD site being below the SQGs. However, concentrations of arsenic, copper, lead, selenium, and vanadium in lichen tissue collected at the RD site did not differ significantly from those at the reference sites, nor did concentrations of any of these metals and molybdenum in sedge tissue differ significantly between the RD site and the pooled reference sites.

Table 3.4: Summary of significantly higher metal concentrations in lichen tissue collected in 2022 at Kemess Underground (KUG), Kemess South (KS), and Road (RD) sites in comparison to Reference sites for those parameters that showed average concentrations above the applicable Sediment Quality Guidelines from at least one Project Footprint site.

Parameter	Reference Sites Average	Kemess Underground Site	Kemess South Site	Road Site
Arsenic	0.141	Yes	No	No
Copper	5.779	No	Yes	No
Lead	0.464	Yes	No	No
Molybdenum	0.205	Yes	Yes	Yes
Selenium	0.100	Yes	No	No
Vanadium	0.952	Yes	No	No

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline at Specified Project Footprint Study Area.

Note: "Yes" indicates significantly higher concentration occurred at the Project footprint study area compared to the reference stations, whereas "No" indicates no significant difference between these two areas based on a p-value of 0.1.

Table 3.5: Summary of significantly higher metal concentrations in sedge tissue collected in 2022 at Kemess Underground (KUG), Kemess South (KS), and Road (RD) sites in comparison to Reference sites for those parameters that showed average concentrations above the applicable Sediment Quality Guidelines from at least one Project Footprint site.

Parameter	Reference Sites Average	Kemess Underground Site	Kemess South Site	Road Site
Arsenic	0.027	No	No	No
Copper	4.633	No	No	No
Lead	0.037	No	No	No
Molybdenum	2.263	No	No	No
Selenium	0.149	No	No	No
Vanadium	0.134	No	No	No

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline at Specified Project Footprint Study Area.

Note: "Yes" indicates significantly higher concentration occurred at the Project footprint study area compared to the reference stations, whereas "No" indicates no significant difference between these two areas based on a p-value of 0.05.

3.2.2. Temporal Comparisons

Lichen tissues collected at the KUG site in 2022 showed significantly higher concentrations of arsenic, lead, selenium, and vanadium compared to data collected in the 2014 baseline study (Table 3.6). Concentrations of these metals were also shown to be significantly higher in lichen tissues at KUG compared to the pooled reference sites in 2022 (Table 3.4). However, as very limited construction and mining activity has occurred at the KUG site, the 2022 results represent conditions that are consistent with 2004 and 2006 baseline study findings outlined in Roberts (2006) and Gartner Lee Limited (2008), respectively. Furthermore, higher concentrations reported in 2022 may reflect sampling variations relative to earlier studies with respect to lichen collection procedures and/or differences in types of lichens sampled (e.g. foliose versus reindeer lichen, or the proportions thereof). In contrast to lichen tissues, concentrations of all metals of potential concern in sedge tissues did not differ significantly between the 2022 study and 2007/2014 baseline studies conducted at the KUG site (Table 3.7). These results were consistent with a lack of significant differences in concentrations of the same metals between the KUG and pooled reference sites for sedge tissues collected in 2022, which collectively indicated no mine-related influences on metal concentrations in sedge tissues at the KUG site since 2014.

Table 3.6: Summary of significantly higher metal concentrations found in lichen tissue collected in 2022 at Kemess Underground (KUG), Kemess South (KS), and Road (RD) sites in comparison to respective 2007/2014 baseline data.

Parameter	Kemess Underground Site	Kemess South Site	Road Site
Arsenic	Yes	No baseline data	No baseline data
Copper	No	No baseline data	No baseline data
Lead	Yes	No baseline data	No baseline data
Molybdenum	No	No baseline data	No baseline data
Selenium	Yes	No baseline data	No baseline data
Vanadium	Yes	No baseline data	No baseline data

Shading indicates parameter concentration in soil equal to or above applicable Sediment Quality Guideline at Specified Project Footprint Study Area.

Note: "Yes" indicates parameter concentration significantly higher at the respective Project footprint area in 2022 compared to baseline data collected in 2007 and/or 2014. "No" indicates no signficant difference, or significantly lower concentration, of the parameter in vegetation tissue samples collected at the Project footprint area in 2022 compared to baseline data collected in 2007 and/or 2014.

Table 3.7: Summary of significantly higher metal concentrations found in sedge tissue collected in 2022 at Kemess Underground (KUG), Kemess South (KS), and Road (RD) sites in comparison to respective 2007/2014 baseline data.

Parameter	Kemess Underground Site	Kemess South Site	Road Site
Arsenic	No	No baseline data	No baseline data
Copper	No	No baseline data	No baseline data
Lead	No	No baseline data	No baseline data
Molybdenum	No	No baseline data	No baseline data
Selenium	No	No baseline data	No baseline data
Vanadium	No	No baseline data	No baseline data

Shading indicates parameter concentration in soil equal to or above applicable Sediment Quality Guideline at Specified Project Footprint Study Area.

Note: "Yes" indicates parameter concentration significantly higher at the respective Project footprint area in 2022 compared to baseline data collected in 2007 and/or 2014. "No" indicates no signficant difference, or significantly lower concentration, of the parameter in vegetation tissue samples collected at the Project footprint area in 2022 compared to baseline data collected in 2007 and/or 2014.

At the KS site, concentrations of all metals of potential concern in shrub tissues were not significantly higher in 2022 compared to 2014, except for selenium (Table 3.8). However, selenium concentrations in soil at the KS site were below SQGs, suggesting that the differences in selenium concentrations in shrub tissues between 2022 and 2014 were unlikely to be associated with differences in shrub uptake of this metalloid, and most likely due to slight differences in sampling design between the two studies. In particular, the differences in selenium concentrations of shrub tissue between studies may reflect the sampling of red willow in 2022 versus sampling a combination of six other willow species in 2014 (see Ardea 2015), which potentially highlights the natural variation in selenium uptake between the willow species sampled in the 2022 and 2014 studies.

Table 3.8: Summary of significantly higher metal concentrations in shrub tissue collected in 2022 at Kemess Underground (KUG), Kemess South (KS), and Road (RD) sites in comparison to respective 2007/2014 baseline data.

Parameter	Kemess Underground Site	Kemess South Site	Road Site
Arsenic	No comparison possible	No	No baseline data
Copper	No comparison possible	No	No baseline data
Lead	No comparison possible	No	No baseline data
Molybdenum	No comparison possible	No	No baseline data
Selenium	No comparison possible	Yes	No baseline data
Vanadium	No comparison possible	No	No baseline data

Shading indicates parameter concentration in soil equal to or above applicable Sediment Quality Guideline at Specified Project Footprint Study Area.

Note: "Yes" indicates parameter concentration significantly higher at the respective Project footprint area in 2022 compared to baseline data collected in 2007 and/or 2014. "No" indicates no signficant difference, or significantly lower concentration, of the parameter in vegetation tissue samples collected at the Project footprint area in 2022 compared to baseline data collected in 2007 and/or 2014.

4. Discussion

The design used for soil and vegetation sampling in 2022 allowed for the screening of metal concentrations in relation to established SQGs and the evaluation of changes in metal concentrations between 2022 and earlier baseline studies (2003 to 2014) for sites within the Project footprint, as required under the EMP. In addition to meeting these EMP objectives, the study design implemented in 2022 included sample station replication, establishment of distinct KUG, KS, and RD Project footprint sites, and the inclusion of reference sites. The design of the 2022 study allowed for statistical approaches to identify potential differences in metal concentrations in soil and vegetation at the Project footprint sites compared to reference conditions, and a statistical foundation to track changes in metal concentrations at individual sites within the Project footprint over time. Therefore, it is important that future soil and vegetation sampling for the EMP is conducted at the same replicate station locations within the KUG, KS and RD sites (see Appendix C) using the same sampling methodology and types of statistical analyses applied in 2022 to allow for a scientifically defensible evaluation of temporal changes in metal concentrations in soil and vegetation over time.

At the KUG site, no mining activities occurred prior to the KS Mine being placed in Care and Maintenance in 2011 and little development/disturbance progressed prior to the KUG Project being placed in Care and Maintenance in 2020. Therefore, the soil and vegetation sampling and analyses conducted in 2022 and previously at the KUG site are reflective of natural baseline (pre-existing) conditions prior to the development of the KUG Project. In 2022, although mean concentrations of arsenic, copper, lead, molybdenum, selenium, and vanadium in soil were above SQGs at the KUG site, similar elevated concentrations of these metals relative to SQGs were found in previous baseline monitoring. While lichen tissue collected in 2022 contained higher concentrations of key metals of concern (i.e., arsenic, copper, lead, molybdenum, selenium, and vanadium) at the KUG site compared to reference sites and to other KUG site baseline data, metal concentrations in sedge samples from the KUG site in 2022 were similar to those shown in previous baseline studies. Also, it is important to point out that differences in lichen sampling methodologies and locations between 2022 and previous baseline investigations could explain differences in metal concentrations of lichen tissues between the 2022 and previous baseline studies. Hence, standardized sampling protocols and established sampling stations are recommended from this point forward. In addition, temporal changes to metal concentrations in soil and lichen samples relative to respective SQGs and/or earlier baseline monitoring data may simply reflect natural spatial variability associated with different sampling station locations between studies. In part, this spatial variability may represent natural metal-enrichment of geological material associated with the mineral deposits at the KUG site being reflected in metal concentrations of soil at this site. The 2022 vegetation monitoring results corroborated the findings of previous baseline investigations by Roberts (2006) and Gartner Lee Limited (2008), which likewise reported the occurrence of naturally elevated metal concentrations in vegetation at the KUG site.

A Human Health Follow-up Program (HHFP) was developed for the KUG Project (AuRico, 2020; Appendix B), in which acceptable levels of change in environmental conditions for Project construction and/or operation phases were outlined, as well as thresholds in Section 5 for changes in conditions during either Project phase that would trigger an assessment of impacts to country foods as part of a Human Health Risk Assessment (HHRA). Specifically, the HHFP states that if soil and vegetation quality monitoring conducted as part of the EMP identifies concentrations of COPCs that exceed predicted concentrations for the Project during construction or operation phases for at least three consecutive three-year sampling cycles (i.e., nine years), a HHRA for country foods is triggered. The HHFP also states that if no changes in concentrations of COPCs occur in environmental media such as soil and vegetation over the course of Project construction and/or operation, the quality of country foods is unlikely to have changed and thus a HHRA is not required.

As the KUG Project currently remains in Care and Maintenance (neither in construction nor operation), soil and vegetation samples collected in 2022 in accordance with the EMP continue to reflect baseline conditions for which the HHFP criteria and triggers currently do not apply. Nevertheless, the 2022 (and previous baseline) data confirm that the COPCs identified in the HHFP serve as suitable parameters from which to base trigger criteria for the requirement to conduct a HHRA for country foods. In particular, arsenic, copper, lead, molybdenum, selenium, and vanadium are suggested as key COPC parameters for HHFP evaluations based on concentrations of these metals in soil naturally

elevated above SQGs at one or more of the KUG Project sites in 2022 and/or earlier baseline studies. The HHFP indicated that a 30% increase (or 40% for 'high variability' parameters) in the concentration of a COPC from established baseline concentrations during the construction and/or operational phases of the KUG Project would serve to trigger a HHRA. Based on review of baseline soil and vegetation chemistry data from 2022 and earlier studies, as well as data from reference sites sampled in 2022, the metal concentrations in both types of media in 2022 were naturally greater than 30% to 40% of the respective mean concentrations from the previous baseline studies. Therefore, the triggers for implementation of a HHRA under the current HHFP may be too conservative and thus potentially lead to a false-positive response (i.e., an HHRA is triggered, despite no empirical data supporting a Project-related increase in a COPC concentration relative to established baseline concentrations). Thus, the results of this 2022 study suggest that a statistical approach that accounts for natural variability in COPC concentrations, such as a mean concentration (baseline or reference) plus two standard deviations, which serves as an 'effects' benchmark for environmental effects monitoring (EEM), should be considered as a trigger for a HHRA under the HHFP for the KUG Project in the future, rather than the current trigger of simply a greater than 30% or 40% change from the established baseline concentration mean.

5. Conclusions

Trace metal monitoring of soil and vegetation was conducted at the Kemess Mine in 2022 in accordance with the mine-specific EMP as a basis for assessing whether Project-related activities have resulted in any increases of metal concentrations above applicable SQGs for soil and baseline conditions for vegetation. As stipulated in the EMP, this sampling was conducted to match the frequency of updates for the mine's Reclamation and Closure Plan, which was also conducted in 2022.

The 2022 monitoring study employed a robust sampling approach that incorporated similar sampling methods used during earlier baseline studies but at a greater number of sites (KUG, KS, and RD) and at sufficient replication to allow for statistical assessment of existing data, as well as to adequately compare data collected in 2022 to data collected in the future. The principal conclusions from the 2022 monitoring study are:

- At the KUG site, although soils and lichen samples collected in 2022 showed concentrations of arsenic, copper, lead, molybdenum, selenium, and/or vanadium above applicable SQGs (soil only) and in comparison, to reference sites, these results generally reflected background (i.e. baseline) conditions for the site due to of natural metal-enrichment of soils (and subsequent uptake by vegetation) associated with geological mineralization of the KUG site.
- At the KS site, although soil samples showed elevated concentrations of copper and molybdenum relative to SQGs, concentrations of these and other metals of concern in vegetation did not differ from those at the reference sites, indicating no adverse uptake in plants. Although some differences in metal concentrations occurred in lichen tissue between 2022 and previous baseline studies at the KS site, differences in sampling methodology and station locations between 2022 and previous baseline monitoring likely accounted for the variations that were documented between these baseline periods.
- At the RD site, average metal concentrations in soil were below SQGs and no significant differences for metal concentrations in vegetation were indicated relative to reference sites in 2022, affirming no Project-related influences on soil and vegetation chemistry at this site to date.

The monitoring design employed in 2022 achieved the EMP objectives established for evaluating soil quality relative to conservative SQGs, as well as for evaluating vegetation chemistry relative to baseline data, while further establishing a robust Project-related baseline condition for the KUG, RD, and reference sites. Overall, the 2022 data provides a baseline which may be used for the future evaluation of Project-related influences upon further development. Future monitoring and data assessment under the Kemess Mine EMP should include the same sites (KUG, KS, RD, REF1, REF2, REF3), station replication, field sampling procedures, and data analysis methods used in 2022 to provide consistency in Project-related evaluation and tracking of metal concentrations of soil and vegetation for the program over time.

Respectfully,

Ryan Trudeau, B.Sc., R.P.Bio

Environmental Coordinator
Kemess Mine
Ryan.Trudeau@Centerragold.com
604-424-8200 x13823

Lucas Krist, B.A.Sc., E.I.T.

Environmental Coordinator
Kemess Mine
Lucas.Krist@Centerragold.com
604-424-8200 x13833

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APPENDIX A

Kemess Underground Project: Ecosystem Management Plan

KEMESS UNDERGROUND PROJECT

Ecosystem Management Plan

Version: 2.0

Date: May 2018

AuRico Metals Inc.
110 Yonge Street, Suite 601
Toronto, ON
Canada M5C 1T4
T: (416) 216-2780
F: (416) 216-2781

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Ecosystem Management Plan

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AuRico	AuRico Metals Inc.
BC	British Columbia
BC CDC	British Columbia Conservation Data Centre
BC EAO	British Columbia Environmental Assessment Office
BC MEM	British Columbia Ministry of Energy and Mines
BC MFLNRO	British Columbia Ministry of Forests, Lands and Natural Resource Operation
BC MOE	British Columbia Ministry of Environment
BMP	Best management practice
CCME	Canadian Council of Ministers of the Environment
CEO	Chief Executive Officer
COO	Chief Operating Officer
DFO	Fisheries and Oceans Canada
dw	Dry weight
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
ECCC	Environment and Climate Change Canada
EMC	Environmental Monitoring Committee
EMP	Environmental Management Plan
EMS	Environmental Management System
GIF	Ground Inspection Form
GPS	Global Positioning System
ICPMS	Inductively Coupled Plasma Mass Spectrometry
ID	Identification

IEM	Independent Environmental Monitor
kg	Kilogram
KS	Kemess South
KUG	Kemess Underground Project
mg	Milligram
ML/ARD	Metal leaching/acid rock drainage
OGMA	Old-growth Management Area
ORAR	Omineca Resource Access Road
Plan, the	Ecosystem Management Plan
QA/QC	Quality assurance and quality control
QP	Qualified professional
RCP	Reclamation and Closure Plan
RSBC	Revised Statutes of British Columbia
SOP	Standard Operating Procedure
TKN	Tse Keh Nay
TSF	Tailings storage facility

1. PURPOSE AND OBJECTIVES

The purpose of the Ecosystem Management Plan (the Plan) is to provide guidance on minimizing adverse effects to ecosystem functions within the Project footprint, throughout all phases of the Project. This plan provides management strategies for maintaining ecosystem integrity during the Project's Construction and Operation activities and for the restoration of ecosystem functionality throughout progressive reclamation and Closure activities.

The Plan is intended to provide guidance on the following topics:

- Vegetation management – including standard operating procedures for addressing riparian areas, mature forests, rare and at risk species and ecosystems, large/coarse woody debris, and trace metal uptake in soils and vegetation; and
- Wetlands management – including for the KUG tailings storage facility (TSF) Discharge pipeline access corridor.

Management of invasive plant species is covered under the Invasive Plant Management Plan.

The Plan includes the following performance objectives:

- Minimize the loss or alteration of ecosystem functions related to the Project by adhering to prescribed clearing areas;
- Avoid and minimize detrimental effects to rare and at risk species or their habitat by adhering to guidance provided in the Ecosystem Management Plan;
- Avoid the introduction and spread of invasive plants by adhering to the Invasive Plant Management Plan;
- Avoid and minimize detrimental effects to wetland functions by adhering to guidance provided in the Ecosystem Management Plan;
- Minimize impacts to the wetland from the discharge pipeline within the access corridor;
- Monitor the KUG TSF discharge pipeline access corridor through the wetland to identify and detect potential changes to hydrologic function and plant species composition;
- Maintain wetland hydrologic functions and vegetation community composition and health; and
- Monitor the effectiveness of mitigation measures employed and implement adaptive management if negative trends associated with Project activities are identified.

2. PLANNING

2.1 ROLES AND RESPONSIBILITIES

2.1.1 Human Resources

AuRico's Executive Management Team will allocate the appropriate human resources to the Environmental Management Plans (EMPs) for the Project. AuRico's Board of Directors has a Technical and Sustainability Committee to assist the Board in overseeing related initiatives and the proper implementation of applicable policies. The Committee periodically reviews sustainability-related policies, programs, and performance.

The roles and responsibilities for personnel are listed below and address the need for on-site personnel to communicate ultimately to the Executive Management Team on sustainability management at the Project. The responsibilities will enable effective management of environmental, commitments, and early warning and response to environmental issues, compliance with regulatory and policy requirements, and the evaluation and revision of environmental performance. The responsibilities are ultimately aimed at demonstrating diligence and transparency in AuRico's environmental and sustainability management.

Based on the current construction and operations phases workforce envisaged for the Project, the following is the proposed organizational structure and responsibilities. It should be noted that refinement and confirmation of the organizational structure will emerge as the project progresses. The organizational arrangement of the personnel responsible for environmental-related aspects is as follows:

- Chief Executive Officer (CEO);
- Chief Operating Officer (COO);
- Director Environment;
- General Manager;
- Front Line Supervisors;
- Environmental Superintendent;
- Environmental Technicians;
- Environmental Assistants;
- Aboriginal Group Monitors; and
- Employees and Contractors.

2.1.1.1 Chief Executive Officer

The Chief Executive Officer (CEO) will carry the ultimate responsibility for environmental and sustainability management, both in terms of statutory compliance as well as corporate citizenship, and will direct, instruct, and approve the implementation of such management policy on site.

2.1.1.2 Chief Operating Officer

The Chief Operating Officer (COO) will ensure that the resources required for developing, applying, and monitoring an effective EMP are available. In this respect, the COO will maintain a reporting-function relationship with the Director Environment and the General Manager.

2.1.1.3 Director, Environment

The Director, Environment will be responsible for the development, application, and monitoring of an effective Environmental Management System (EMS) and array of relevant EMPs and communications with government and community, including First Nations groups.

2.1.1.4 General Manager

The on-site General Manager will carry the accountability for the Project's environmental performance, as one of a portfolio of management responsibilities. The General Manager will instruct and approve the on-site systems and resources, by delegation to appropriate line-function personnel and with the support and advice of Mine management and supervision for planning, oversight, monitoring, and reporting.

2.1.1.5 Management and Supervisors

Management and Supervisors will have the functional responsibility for all matters related to day-to-day environmental management and will ultimately report to the General Manager. They will interact via a supporting role with relevant on-site personnel that have specified environmental management responsibilities.

Management and Supervisors will maintain a scheduled and systematic approach to monitoring of environmental performance and follow approved EMPs and conditions, and include compiling, reviewing, and seeking approval from the General Manager, Environmental Superintendent (or delegate) for environmental management method statements and work instructions.

2.1.1.6 Environmental Superintendent

The Environmental Superintendent will have the functional responsibility for environmental management matters at the Project and will provide reporting-function accountability to the General Manager and to the Director, Environment. The Environmental Superintendent will interact with and direct on-site Environmental Technicians and Assistants to fulfill environmental management responsibilities and tasks and ensure contractors are compliant with EMP requirements. This includes ensuring programs and procedures to fulfill the EMPs are designed, implemented and reported on for internal sustainability and external permit or regulatory commitments. The Environmental Superintendent will be responsible for communications with government and community, including First Nations groups.

2.1.1.7 Environmental Technicians and Assistants

Environmental Technicians and Assistants will be responsible for implementing the various EMPs and permit monitoring measures for the Project. They will be under the direction of and will be accountable to the Environmental Superintendent. The Environmental Technicians and Assistants will complete the day-to-day tasks to fulfill EMP obligations, sample collection, on-site monitoring and reporting. This includes performing environmental monitoring roles during Construction and Operations. Environmental Assistants will complete tasks as directed to support responsibilities of the Environmental Technicians and Environmental Superintendent.

2.1.1.8 Aboriginal Group Monitors

In accordance with KUG EA Conditions (2017), AuRico must provide opportunities for one full time position of an Aboriginal Monitor from each of the Aboriginal Groups (Tsay Keh Dene, Kwadacha, and Takla) to the satisfaction of BC EAO during Construction and Operations. Each Aboriginal Monitor reports information directly to their respective Aboriginal Group and is subject to safety requirements established by AuRico, and receives direction for the activities to monitor from the respective Aboriginal Group. AuRico must:

- Provide documents required by the EA Certificate to the Aboriginal Monitors for review consistent with the review timelines identified in the conditions requiring the documents in addition to the other parties identified in each condition requiring documents;
- Provide training opportunities for Aboriginal Monitors so that the Aboriginal Monitors have the ability to support effective participation in monitoring activities; and
- Provide opportunities for the Aboriginal Monitor to conduct environmental monitoring for the Project.

Further details of the role of the Aboriginal Monitor are included in the Terms of Engagement for the Aboriginal Monitors.

2.1.1.9 Employees and Contractors

An environmental orientation will be developed for AuRico personnel and contractors involved in the Project and will include EMP actions specific to the activities in which they will be involved. A key component of this orientation is a clear explanation of each individual's role and responsibility in the environmental management of the Project.

<u>Contractors' Personnel</u>

Contractors that undertake aspects of the Project will be required to meet the prescribed environmental performance standards set by AuRico's EMPs. Contractors will require designated personnel to ensure compliance. Such personnel will typically provide an environmental oversight role for activities associated with the particular contract being carried out; in addition to other duties and responsibilities. AuRico's Management, Supervisors and Environmental Superintendent will interact closely with the contractor's personnel to identify the environmental requirements. The Contractor's representative(s) will be responsible for ensuring compliance with the

environmental requirements including undertaking regular inspections, recording and reporting on inspection findings, initiating corrective actions for non-compliance, and maintaining an acceptable level of training and awareness among the contractor's personnel.

2.1.2 Qualified Professional

AuRico will retain various Qualified Professionals to conduct various aspects of the Project's environmental monitoring as specified in various EMPs. A Qualified Professional is a person who has training, experience and expertise in a discipline relevant to the field of practice set out in the condition or regulation, and who is registered with the appropriate professional organization, is acting under that organization's code of ethics and is subject to disciplinary action by that organization.

2.1.3 Independent Environmental Monitor

In accordance with the KUG EA Conditions (2017), AuRico will retain the services of a Qualified Professional to act as an Independent Environmental Monitor (IEM). AuRico will retain the IEM throughout all Project phases. The IEM will:

- Observe and record for, and report to, the BC EAO on compliance with the Certificate; and
- Provide information to BC EAO, BC MEM, BC MOE, BC MFLNRO and Aboriginal Groups, as directed by BC EAO.

When providing information or reports to BC EAO, the IEM must not provide such information or reports to AuRico in advance of providing such information or reports to BC EAO.

Details on the role and responsibilities of the IEM are provided in the Terms of Engagement for the IEM.

2.1.4 Environmental Monitoring Committee

In accordance with the KUG EA Conditions (2017), AuRico must establish and maintain an environmental monitoring committee (EMC) for all phases of the Project.

AuRico must invite participation from Aboriginal Groups, BC MOE, BC MEM, BC MFLNRO, BC EAO, and other agencies where relevant to particular topics being discussed. The purpose of the EMC is to facilitate information sharing and provide advice to AuRico on the ongoing development of the Project and mitigation measures in a coordinated and collaborative manner.

Further details on the role of the EMC are included in the Terms of Reference for the EMC.

2.1.5 Material Resources

The implementation of EMPs requires material resources to be allocated for particular actions and procedures. AuRico's Environmental Policy provides for material resources via the mandates contained in the responsibilities for key personnel. Material resources in the form of salaries, equipment, facilities and consumables will be provided for implementing EMPs. Furthermore,

budgets, facilities, and materials will be provided for the training of personnel who have the responsibility of meeting environmental performance targets and fulfilling the EMPs.

2.2 COMPLIANCE OBLIGATIONS

2.2.1 Legislation and Regulations

There are several regulations and guidelines applicable or relevant to Ecosystem Management. These include:

- *Mine Health Safety and Reclamation Code of British Columbia* (BC MEMPR 2008) – this act provides guidance on the operation and reclamation of existing and abandoned mines. Section 10.7.7 states that "on all lands to be re-vegetated, land shall be re-vegetated to a self-sustaining state using appropriate plant species";
- BC *Weed Control Act* (1996) – imposes a duty on all land occupiers to control designated noxious plants;
- *Species at Risk Act* (2002) – federal legislation that aims to protect species at risk from becoming extinct. Specifies that invasive plant species that threaten rare wildlife species' habitat must be controlled;
- BC *Integrated Pest Management Act* (BC Hydro 2003) – regulates the use of herbicides to control weeds (invasive plants);
- BC *Forest and Range Practices Act* (2002) – this act and regulation applies constraints to when, where, and how forest clearing is undertaken and applies protection to old forests (through establishment of old-growth management areas; OGMAs) and to riparian areas;
- *Fisheries Act* (1985) – this federal act protects fish and fish habitat across Canada;
- *Migratory Birds Convention Act* (1994) – this Act prohibits the killing of migratory birds or depositing harmful substances in areas frequented by migratory birds, and also protects their eggs and nests;
- *Water Sustainability Act* (2014) – this Act ensures that water quality, fish and wildlife habitat, and the rights of water license users are not compromised; and
- BC *Wildlife Act* (1996) – legal designation as Endangered or Threatened under the Act increases the penalties for harming a species, and also enables the protection of habitat in a Critical Wildlife Management Area.

Matters related to trace metal deposition in soils and uptake in vegetation and their potential impact on various land uses are regulated by the Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 2007). These guidelines provide Canada-wide standards for the maximum limits of various toxic substances (e.g., metals, hydrocarbons, pesticides) in the soil. The Contaminated Sites Regulation (BC Reg. 375/96) included in the BC *Environmental Management Act* (2003) lists Soil Criteria for Toxicity to Soil Invertebrates and Plants. These guidelines and criteria provide numerical standards to define whether a site is contaminated, to determine liability for site remediation, and to assess reclamation success.

For wetlands there are a number of federal and provincial policy statements and acts pertaining to aspects of wetlands such as function, wildlife, and fish habitat, which include:

- Federal Policy on Wetland Conservation (Environment and Climate Change Canada 1991);
- *Migratory Birds Convention Act* (1994);
- *Species at Risk Act* (2002);
- *Fisheries Act* (1985);
- BC *Wildlife Act* (1996); and
- *Forests and Range Practices Act* (2002).

Although no single act specifically addresses all wetlands or wetland functions, the various acts listed above can relate to specific types of wetlands at specific times of the year. For example, some wetlands that provide fish habitat are protected as such under the *Fisheries Act*.

Riparian ecosystems, which can include wetlands, are protected by the *Forests and Range Practices Act* (2002). Recommendations for management zones around riparian and wetland areas are contained within the *Forest Practices Code Riparian Management Area Guidebook* (BC MOE 1995). Furthermore, the provincial best management practices (BMPs; BC MOE 2014) recommend developers avoid ecosystems listed by the BC Conservation Data Centre (BC CDC).

2.2.2 BC EAO Certificate Conditions

The Holder must retain a Qualified Professional to update the Ecosystem Management Plan in Section 24.4 of the Application. The updated plan must be developed in consultation with BC MEM, BC MOE, BC MFLNRO, and Aboriginal Groups, as well as ECCC with respect to the Attichika wetland.

The updated plan must include at a minimum:

a) The means by which the mitigation measures listed in Section 24.4.4 and monitoring measures listed in Section 24.4.5 of the Application will be implemented;

b) The means by which the wetland management and monitoring will be implemented, including at a minimum:

   i. Monitoring prior to and during Construction and Operations, as determined by a Qualified Professional to identify impacts to the Attichika wetland from the discharge pipeline within the access corridor;

   ii. Monitoring prior to and during Construction and Operations as determined by a Qualified Professional to detect potential changes to hydrologic function and plant species composition in the Attichika wetland;

   iii. Adherence with best management practices related to road and utility corridors construction to mitigate effects of the discharge pipeline construction in the Attichika wetland. BMPs must be consistent with those identified in Wetland Ways: Interim

Guidelines for Wetland Protection and Conservation in British Columbia, Wetland Stewardship Partnership, March 2009 (or as replaced or updated from time to time); and

iv. Adaptive management for any Project impacts to the Attichika wetland if those impacts are not mitigated to the extent contemplated in Section 13.5.3.3 of the Application or are not predicted in the Application.

The Holder must provide the plan to BC MEM, BC MOE, BC MFLNRO, ECCC, Aboriginal Groups, and BC EAO a minimum of 45 days prior to the planned commencement of Construction.

The Holder must not commence Construction until the plan has been approved by BC EAO, unless otherwise authorized by BC EAO.

The plan, and any amendments thereto, must be implemented to the satisfaction of a Qualified Professional throughout Construction, Operations and Closure and to the satisfaction of BC EAO.

2.2.3 CEAA Certificate Conditions

The following conditions related to vegetation clearing activities and reclamation were provided in the Decision Statement Issued under Section 54 of the *Canadian Environmental Assessment Act, 2012:*

1. The Proponent shall, prior to construction and in consultation with Indigenous groups and relevant authorities, conduct pre-clearing surveys to identify Western toad (*Anaxyrus boreas*) breeding habitat, and shall implement measures to mitigate the loss of Western toad (*Anaxyrus boreas*) breeding habitat caused by the Designated Project.
2. The Proponent shall conduct pre-clearing surveys to determine the distribution of little brown myotis (*Myotis lucifugus*) and Northern myotis (*Myotis septentrionalis*), and establish, in consultation with Indigenous groups and relevant authorities, buffer zones around active hibernacula and active roosts.
3. The Proponent shall, in consultation with Indigenous groups, undertake progressive reclamation of the habitats disturbed by the Designated Project. The Proponent shall use native species when undertaking that progressive reclamation.

2.2.4 Permit Requirements

Any relevant permits or authorizations will be obtained prior to working in or about any fish bearing stream or wetland area, if applicable. AuRico Metals will obtain any permits that may be required under the BC *Wildlife Act* (1996) for activities such as handling of amphibians.

2.2.5 Guidelines and Best Management Practices

2.2.5.1 Vegetation

BMPs will be employed to mitigate effects to vegetation. The following guidelines will be used as resources for applying BMPs related to vegetation management.

- BC Conservation Data Centre (BC MOE 2007). This provincial agency, part of the Environmental Protection and Sustainability Division in the BC Ministry of Environment, collects and disseminates information on the plants, animals, and ecosystems at risk in BC.
- Windthrow Handbook for British Columbia Forests (Stathers, Rollerson, and Mitchell 1994). This handbook provides guidance on windthrow management.
- Riparian Management Area Guidebook (BC MOE 1995).
- Measures to Avoid Causing Harm to Fish and Fish Habitat Including Aquatic Species at Risk (DFO 2016). This document provides guidance for riparian management in order to avoid and minimize effects to fish and fish habitat.
- Towards an Environmental Mitigation and Offsetting Policy for British Columbia: A Discussion Paper (BC MOE 2010). Provides a framework to consider when setting mitigation strategies for rare organisms and habitats.

2.2.5.2 Wetlands

BMPs will be employed to mitigate effects to wetlands. The BMPs will be consistent with those identified in *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia, Wetland Stewardship Partnership*, (Cox and Cullington 2009). The following BMPs were developed for mine Construction, Operation, and Closure phases:

- Conserving intact wetlands where possible through avoidance and minimization of footprints;
- Controlling sediment and erosion and deposition in wetlands;
- Limiting effects to wetland hydrology through appropriate construction methods and water control measures;
- Limiting effects to vegetation communities through targeted clearing and reducing dust and effects to wetland hydrology;
- Using low impact natural re-vegetation techniques whenever possible; and
- Re-establishing wetland functions during Closure.

3. SUPPORT

3.1 TRAINING AND AWARENESS

All staff will attend site orientation where the contents, requirements and commitments made in this plan will be communicated. Staff will be adequately trained to implement this plan and will be aware of AuRico's commitments to uphold this Ecosystem Management Plan. All personnel will be provided with information during Orientation to facilitate the reporting of any incident or concern during each phase of the Project. Personnel will be instructed to communicate any concerns including erosion and sediment production, windthrow, invasive plants, wetlands, and unauthorized access to restricted areas to the Environmental Superintendent.

4. IMPLEMENTATION

4.1 IMPLEMENTATION SCHEDULE

The Ecosystem Management Plan will be applied during all Project phases (i.e., Construction, Operations, Closure, and Post-closure).

4.2 VEGETATION

4.2.1 Environmental Protection Measures General Approach

Actions will be taken to minimize the environmental effects on terrestrial ecosystem functions and integrity through all phases of the Project. The Ecosystem Management Plan supports the application of the environmental protection measures described below. The Ecosystem Management Plan will be implemented in coordination with other relevant Management Plans throughout the life of mine when conducting activities that alter ecosystem functions.

The spatial extent of Project disturbance will be restricted to the area required to safely and adequately construct and operate mine infrastructure to limit the effects on terrestrial ecosystems by implementing the following actions:

- Utilize existing Kemess South (KS) facilities to the greatest extent possible to reduce additional disturbance;
- Avoid clearing within identified sensitive areas;
- Adhere to best management practices for soil handling and stockpiling, in accordance with the Soil Salvage Management Plan and the Soil Stockpiling Procedure;
- Survey and mark out limits of planned disturbance; and
- Limit vehicles to defined roads or clearings and avoid vehicle traffic in undisturbed areas.

Selective control of vegetation along mine site roads and rights-of-way may be routinely required. Managing brush and trees along the mine site roads and rights-of-way should be selectively controlled on a priority basis to achieve the following:

- Maintain safe visibility (i.e., sight lines) along the pedestrian footpaths (i.e., from Camp to the Administration Complex) to ensure that wildlife (i.e., bears) in the vicinity are visible to pedestrians from the pathway;
- Maintain safe visibility at road crossings to reduce the potential for vehicular accidents; and
- Reduce physical hazards to mine crews.

4.2.1.1 Re-vegetation

Exposed soil surfaces will be progressively revegetated during the appropriate growing season and conditions using seeds (and/or plants) suitable for the local area and ecosystems to avoid erosion and

sedimentation, introduction of invasive plants, and to facilitate the re-establishment of ecological function in the affected area. Details on progressive reclamation of exposed surfaces is provided in the Reclamation and Closure Plan.

When planning the re-vegetation of a disturbed site, AuRico will adopt an approach that emphasizes the use of native plant species. In order to facilitate the application of native species during final reclamation, the following actions will be progressively advanced throughout the mine life:

- Identify native plant species suitable for application in the reclamation of each disturbed site;
- Determine methods of propagation for each species identified;
- Identify commercial seed sources (if available) for the species identified; and
- Assess the feasibility of using the species identified at a scale appropriate to the site being reclaimed.

The greenhouse at the KS Mine will enable the on-site monitoring and evaluation of local species for their suitability in reclamation, as well as progressive reclamation research (e.g., soil suitability and plant community development). Equipped with an overhead misting system and automatic venting, the greenhouse can facilitate studies on various methods of propagation and monitor growth for select species to determine suitability for reclamation. It can support the propagation of locally collected seeds to provide stock for specialized planting programs.

Further information on re-vegetation is provided in the Reclamation and Closure Plan.

4.2.1.2 Riparian Areas

Riparian areas within the Project footprint will be managed according to the recommended management zone setbacks and work practices provided in the *Mines Act* (1996) and *Forest and Range Practices Act* (2002a).

The following general environmental protection guidelines will be followed for all Project-related activities located in riparian areas and must be adhered to while working in or near riparian buffer areas:

- Implement erosion and sedimentation control measures within the Project area to avoid the deposition of deleterious substances in waters frequented by fish;
- Support the maintenance of riparian area function through the use of management area buffers around riparian areas in close proximity but not directly affected by Project construction;
- Avoid the application of pesticides in riparian areas or if required, apply pesticides in compliance with applicable Pesticide Use Permit;
- Restrict size and potential imprint from (i.e., low ground pressure) tracks or tires from heavy equipment in the riparian vegetation management area unless detailed in an authorized prescription;

- Avoid crossing through streams by vehicles and/or heavy machinery (unless at an existing road or ford crossing) unless detailed as a special provision in a site-specific prescription or with specific regulatory agency approval;
- Restrict debris from remaining within the high-water mark or placed into a stream without specific regulatory agency approval;
- Restrict bank disturbance without specific regulatory agency approval;
- Avoid refueling of hand tools (chainsaws, etc.) within at least 15 metres (m) of a waterbody;
- Minimize disturbance of low-growing shrub or grass species;
- Fall trees directionally away from stream banks and aquatic areas to the extent allowed by the need to maintain safe working clearances from the electrical system; and
- Complete site restoration works during optimal seasonal timing (e.g., planting is best done in the spring and fall).

A Standard Operating Procedure (SOP) will be developed as needed for work required in riparian areas to ensure that the specific area needs are considered.

4.2.1.3 Mature Forests

The following general environmental protection guidelines will be considered for all Project-related clearings of mature forests and must be adhered to while working in or near mature forested areas:

- If clearing of mature forest occurs between May and September 30, then pre-clearing surveys will be conducted to determine if any potential bat roosts identified during pre-construction surveys are active; as further described in the Wildlife Management and Monitoring Plan.
- Coordinate clearing activities with the pre-clearing survey requirements outlined in the Wildlife Management and Monitoring Plan.

A Standard Operating Procedure will be developed as needed for work required in mature forested areas to ensure that the specific area needs are considered.

4.2.1.4 Rare and at Risk Species and Ecosystems

Protection and management direction for rare and at risk species is required for each species occurrence and must be specific to the requirements of that species. Impacts to rare plant and at risk species and ecosystems will be minimized through the following actions:

- Optimizing alternatives to avoid rare plant and at risk species and ecosystems, where feasible;
- Applying adaptive Project design changes that avoid harm to rare plant and at risk species and ecosystems, where feasible; and
- Adherence to best management practices (described below).

The following best management practices will be applied to vegetation-clearing activities as appropriate to help avoid and reduce impacts to rare plant and at risk species and ecosystems:

- The known location of rare plant and at risk species and ecosystems will be considered in relation to planned Project activities;
- Avoid use of herbicide sprays within 200 m of rare plant and at risk species and ecosystems and limit such use to direct application rather than broadcast sprays;
- Create no-work-zones around known rare plant and at risk species and ecosystems, wherever feasible, to avoid direct disturbance and to minimize effects related to fugitive dust transport, weed invasion, vehicular activities, and accidental chemical spills; and
- Where avoidance is not feasible and development is required within a no-work-area around rare plant and at risk species and ecosystems, erect temporary fencing or other barriers around the nearby rare plant and at risk species and ecosystems to avoid further disturbance to the site.

A Standard Operating Procedure will be developed as needed for work required in areas with identified rare and at risk species to ensure that the specific area needs are considered. This may include an illustrated listing of the rare plants in the area to provide a reference for those performing the work.

4.2.1.5 Large/Coarse Woody Debris

Large/coarse woody debris removed from the surface during disturbance will be stored separately for use in reclamation. Large/coarse woody debris shall be prescribed as an application to growth media in designated areas during final reclamation. It will be applied to surfaces where feasible and available in order to augment local surface roughness, assist in creating microsites, and provide wildlife habitat.

A Standard Operating Procedure will be developed as needed for work required in areas with large and coarse woody debris with an identified storage area until required.

4.3 WETLANDS

No wetland loss is anticipated associated with the Project (EAC Application Chapter 13 Terrestrial Ecology). However, some wetland alteration may occur associated with construction of the KUG TSF Discharge Waterline. Wetland management and mitigation measures will focus on the one Attichika wetland that will be directly affected by the Project. However, mitigation measures such as sediment and erosion control and water quality monitoring will be employed across the Project site and will ensure that indirect negative effects to wetlands do not occur as a result of Project activities.

4.3.1 Environmental Protection Measures – General Approach

During the Construction and Operations Phases, the objective of the Ecosystem Management Plan is to protect wetlands by applying the general measures outlined below:

- Maintain wetland hydrologic functions by using construction methods appropriate for wetlands;
- Minimize effects to wetland vegetation communities by minimizing clearing;

- Prevent the establishment and spread of invasive plant species by implementing the Invasive Plant Species Management Plan;
- Eliminate or minimize erosion and sedimentation and hydrologic impacts by retaining riparian buffers and diverting surface water to settlement ponds and implementing the Surface Erosion Prevention and Sediment Control Plan;
- Construct roads and ditches to avoid impacts to wetland hydrology by providing adequate cross drains and by not locating outlets/inlets in wetlands (except to maintain existing water flow);
- Prevent infilling by placing and protecting fill or disturbed soils so that they cannot be transported to wetlands; and
- Adaptively manage impacts to the Attichika wetland that exceed those predicted in the EAC Application.

Control potential effects to wetland water quality by following the:

- Metal Leaching/Acid Rock Drainage Characterization and Management Plan;
- Mine Site Water Management Plan, i.e., Safe Discharge Plans; and
- Surface Erosion Prevention and Sediment Control Plan.

Manage noise during sensitive times by following the Wildlife Management and Monitoring Plan.

4.3.2 Wetland Management for the KUG TSF Discharge Pipeline Access Corridor

AuRico is committed to ensuring that reasonable effort is applied to reduce impacts to the Attichika wetland from the discharge pipeline access corridor. AuRico will apply BMPs related to road and pipeline construction to mitigate effects of the discharge pipeline construction in the wetland. The BMPs identified below are consistent with those identified in *Wetland Ways: Interim Guidelines for Wetland Protection and Conservation in British Columbia, Wetland Stewardship Partnership* (Cox and Cullington 2009). The Environmental Superintendent will oversee all pre-construction and construction activities described below and will implement or update mitigation measures as required.

4.3.2.1 Timing of Works

- Construction in the Attichika wetlands will occur outside of the critical fishery sensitive windows and breeding bird and rearing seasons if possible.
- Complete the work as quickly as possible by ensuring all necessary equipment and materials are onsite and ready for installation in order to minimize the duration of disturbance.

4.3.2.2 Avoiding and Minimizing Effects

- Use of low ground pressure machinery is required.
- Debris disposal is not permitted in wetland.

- The construction footprint will be clearly flagged and minimized to the smallest area required for construction and operation of the discharge pipeline access corridor.
- Locate landings and other temporary structures a minimum of 20 m outside of wetland areas.
- Minimize disturbance of riparian habitat along the discharge pipeline access corridor, particularly at the streambank of Attichika Creek.
- Retain existing wetland vegetation by avoiding grubbing and blading whenever possible.

4.3.2.3 Tree and Vegetation Clearing in Attichika Wetland

- If construction of the KUG TSF Discharge Waterline occurs between May and August, pre-clearing surveys will occur prior to construction activities to identify active bird nests and to determine if western toads are using nearby shallow open water wetlands for breeding.
- Minimize all clearing dimensions within the Attichika wetland.
- Restrict vegetation removal in wetlands to trees and tall shrubs within the construction footprint or hazard trees required for worker safety.
- Pre-clearing surveys will identify any other environmental values that intersect work zones and require special consideration. These areas must be clearly flagged and correctly mapped and required operating procedures identified for the contractor will be identified by the Qualified Professional (QP).
- Vegetation clearing boundaries must be clearly flagged prior to commencement of clearing activities.
- Avoid damage to residual trees roots or stems as this can increase risk of windthrow and disease.
- Trees felled during clearing may be used as whole logs or chipped for use in road bed construction wetland.
- Fall trees away from wetlands and riparian areas and remove accidentally introduced debris from these areas by hand.

4.3.2.4 Road Construction BMPs to Maintain Wetland Hydrology

- Redirection of surface and subsurface flows will be minimized as much as feasible to maintain the natural hydrograph. Surface runoff will be redirected from hard surfaces (such as the existing roads above the wetlands) to existing drainages (as much as feasible).
- Construction in the Attichika wetland will include measures to maintain an adequate flow of water into and out of the wetland to sustain water levels and drainage patterns including, use of large, angular, rock road base to allow water flow, geotextiles, and appropriate culvert sizes and spacing.
- Ensure that road ditches do not create outlets that will result in drainage of wetland.

4.3.2.5 Sediment and Erosion Control Measures

- Implement the Surface Erosion Prevention and Sediment Control Plan.
- Place sidecast road construction material above the ordinary high water mark of the wetland.
- When clearing in wetland is required, time the clearing according to when grading and construction is ready to proceed.
- Construction of the pipeline corridor from the ORAR to the wetland will ensure that drainage is directed to vegetated areas prior to reaching wetlands, culverts and drainage outlets will be properly engineered to reduce erosion potential.
- Avoid draining road side ditches directly into the wetland.
- Implement, maintain, and monitor the effectiveness of sediment and erosion control measures.

4.3.2.6 Spill Prevention

- Implement Environmental Spill Emergency Plan and Hazardous Materials Management Plan;
- A spill containment kit will be readily accessible onsite in the event of a release of a deleterious substance to the environment and on-site staff will be trained in spill response;
- Machines must be checked for leaks prior to work in the wetland and biodegradable hydraulic fluid must be used for work in the wetland;
- Fuel will be stored at least 100 m from the wetland;
- Refueling or servicing of equipment is not allowed within wetland; and
- Immediately report any spill of a substance of reportable quantities that is toxic, polluting, or deleterious to aquatic life according to the provisions of the Spill Response.

4.3.2.7 Re-vegetation

Re-vegetation requirements will be assessed following construction. Seeding of organic soils will not occur in wetlands unless otherwise specified. Disturbed areas will be allowed to recover through natural re-colonization processes. Should re-vegetation measures be required, the greenhouse at KS Mine can support the propagation of locally collected seeds and cuttings to provide stock for specialized planting programs required for wetland re-vegetation. Re-vegetation will be monitored concurrently with the vegetation monitoring described in Section 3.4.1.

5. MONITORING

5.1 WORK PLANNING AND SCHEDULE

Vegetation and wetland monitoring frequency will vary depending on the Project activity as well as the outcomes of previous year's monitoring. The results of the site visits and mapping will determine if follow-up monitoring in the same or subsequent year is required to confirm that the objectives are

being achieved and to determine if future monitoring is required. Table 5.1-1 provides an example of a future monitoring plan.

Table 5.1-1 lays out the work planning and schedule for the Ecosystem Management Plan. Monitoring will occur between May and September beginning prior to construction to establish baseline data on wetland hydrology and vegetation communities. An Environmental Monitor will be present during construction activities to ensure appropriate mitigation measures are employed and are effective. Monitoring will continue for at least 4 years after construction, if no trends have been detected monitoring will be discontinued. Should negative trends associated with Project activities (e.g., decreasing species biodiversity, changes in species composition or health) be identified, efforts will be made to correct the root cause of the issue (adaptive management or remedial action if required) and monitoring will continue until no trend is detected over a two-year period.

Table 5.1-1. Vegetation Monitoring Schedule

Type of Monitoring Activity	Measurable Parameter	Frequency	Timing	Duration/Phase
Pre-clearing surveys of wetland portion of discharge pipeline	• Western toad breeding habitat	Once, if construction occurs between May and August	Between May and August	Prior to construction of discharge pipeline
Breeding bird surveys	• Active bird nests	Once, if construction occurs between April and August	Between April and August	Prior to construction of discharge pipeline
Pre-clearing surveys of mature forests	• Active little brown myotis and Northern myotis roosts	Once, if construction occurs between May and August	Between May and September 30	Ongoing as required; all phases
Vegetation Clearing	• Clearing dimension size in relation to planned activity	Variable	Between June and October	Ongoing as required; all phases
Re-vegetation	• Re-vegetation timing and seed mix • Percentage cover of live vegetation • Presence of invasive plants • Erosion	Variable	Between June and September	Ongoing as required; all phases
Plant species composition along KUG discharge pipeline corridor within Attichika wetland	• Vegetation species types and cover • Visual assessments of potential wetland hydrologic effects • Presence of invasive plants • Photo plots	Variable	Between June and September	Prior to construction, Construction, Operations

Hydrologic function along KUG discharge pipeline corridor within Attichika wetland	• Wetland extent survey and mapping • Visual assessments • Drainage structure inspections • Wildlife observation	Annual monitoring, and mapping during each Project phase to track changes over time	Between June and September	Prior to construction, Construction, Operations

5.2 MONITORING, MEASUREMENT, ANALYSIS AND EVALUATION

5.2.1 Vegetation

All vegetation monitoring conducted under this plan will be closely tied to the reclamation monitoring associated with the Reclamation and Closure Plan. Further details on reclamation monitoring are provided in the Reclamation and Closure Plan.

5.2.1.1 Objectives

The primary objective of the vegetation monitoring program is to assess whether, as a result of mine activity, there are potential changes in plant species composition or abundance. Furthermore, monitoring and documenting the implementation of mitigation measures relevant to ecosystem management will help determine if measures prescribed under this plan are achieving performance objectives. Vegetation monitoring results will be used to help assess the success of efforts to restore ecosystem function in areas affected by the Project.

5.2.1.2 Methodology

Data on vegetation species types and cover will be gathered during Construction, Operations, and Closure. Invasive species will also be identified if present and will be surveyed in accordance with the Invasive Plant Management Plan. The number of plots will be determined based on the heterogeneity of the vegetation community and the spatial extent of the disturbance footprint. Permanent photo plots will be established in the disturbed areas to provide photographic documentation of conditions and vegetation communities in the disturbed area.

A visual assessment will also be conducted to identify any changes in vegetation health (chlorotic vegetation or signs of inundation or desiccation) or changes in site conditions outside of the plots (i.e., erosion). Photos and notes will be taken to document any findings and will be included in annual reporting.

Monitoring programs will incorporate:

- Total disturbance area;
- Total areas re-vegetated with specific prescriptions recorded;
- Periodic inspections of the re-vegetated areas to assess performance objectives (including photos); and

- Evaluation of the success of vegetation prescriptions and restoration objectives with identification of additional mitigation actions if required.

This can be completed through on ground surveys, aerial photos and satellite data.

Timing for Vegetation monitoring

All vegetation monitoring will occur between June and September.

5.2.1.3 Evaluation of success of vegetation prescriptions

Evaluations of success of vegetation prescriptions will include consideration of successional processes, such as disturbance type, site history, site competition, and germination conditions. Consideration of successional processes will help distinguish natural effects from Project-related effects.

Evaluations will include the following:

- clearing during Construction activities is being minimized;
- appropriate timing and seed mix used,
- comparison of percentage cover of live vegetation with site's prescription,
- presence of invasive plants,
- presence of rare plants.

5.2.1.4 Assessing Reclamation Objectives

If the recovery objective of a site is to a historical state (pre-mining ecosystem) and reclamation undertaken, then benchmarks will be established in order to measure reclamation success. It is recognized that these benchmarks are dynamic in nature and that reclamation sites exist along a gradient of alteration, where restoration end points exist along a similar gradient and are rooted in both ecological and socioeconomic factors.

Evaluations for reclamation efforts will not solely be placed on returning sites fully to a reference state, but will also consider the strategies undertaken for enhancing ecosystem services in transformed landscapes where it is likely to experience departures from the historic range of variability in surrounding systems.

A comparative inventory will be undertaken of pre- and post-mine ecosystems (to site series) for the KUG Project area. The inventory will delineate the pre-mining general ecosystems and site series, identify the area for each (in hectares), and do the same for the predicted post-closure landscape (based on climax stage). The inventory will be useful in developing reclamation prescriptions intended to successfully achieve Code requirements (i.e., minimize the difference between pre- and post-ming land capability).

Alteration and loss of terrestrial ecological conditions was predicted to affect up to 357.1 ha within the EAC Application. Metrics have been identified to assess Project effects and the effectiveness of

mitigation measures. The metrics and assessment processes that will be used to determine loss or alteration of terrestrial ecosystem vegetation communities are described below.

Loss of Ecosystem

Loss of ecosystems will be characterized by the loss of ecosystem surface area that may occur as a result of the Project footprint. Loss will be quantified as the difference between pre-construction vegetated ecosystem area versus post-construction vegetated area. This will be assessed after construction using suitable measuring devices.

Alteration of Ecosystem

Alteration of ecosystem conditions will be assessed by comparing vegetation community baseline data to monitoring data.

Vegetation monitoring results will be compared to the baseline vegetation conditions to identify if conditions have been altered. The cleared area will be measured to identify potential edge effects. Changes in vegetation conditions over time will be assessed using vegetation species baseline and monitoring data. Metrics will include calculations such as the ratio of dominant species to total species (to identify potential changes in structure), presence of invasive plant species, assessments of heterogeneity (Simpson's Index), and changes in species abundance. Based on the vegetation monitoring plots, plot photos, and baseline mapping; changes in vegetation communities, attributable to Project effects, will be mapped and the affected area calculated.

5.2.1.5 Triggers and Response

Loss

If loss of terrestrial ecosystems exceeds the predicted areas (Table 5.2-1), a review of causes and potential mitigation will be initiated. Mitigation may include actions such reclamation of disturbed areas using native plant species.

Alteration

If the total area of ecosystems identified as altered due to Project effects due to changes in vegetation community exceeds those identified in the EAC Application (Table 5.2-1), an assessment of potential causes and appropriate mitigation measures will be conducted. Mitigation will be based on site specific causes but could include measures such as addressing altered hydrologic regimes by improving drainage, removing invasive plant species, or planting native species in disturbed areas.

Table 5.2-1: Summary of Ecosystem Losses and Alterations Predicted in the EA.

Valued Component	BEC Unit	Lost Area (ha)	Alteration Area (ha)
Alpine	BAFAun	1.5	74.7
Parkland	SWBmks	16.6	136.5
Forested	SWBmk	26	101.8
Total Area (ha)		**44.1**	**313.3**

5.2.2 Trace Metal Uptake in Soils

5.2.2.1 Objectives

The primary objective of the trace metal uptake monitoring program is to assess whether, as a result of mine activity, trace element concentrations in soils exceed the concentration limits listed in the *Canadian environmental quality guidelines* (CCME 2017) or the Soil Criteria for Toxicity to Soil Invertebrates and Plants listed in the Contaminated Sites Regulation (BC Reg. 375/96) included in the BC *Environmental Management Act* (2003).

5.2.2.2 Methodology

Trace metal concentrations in soil will be monitored in samples collected from areas disturbed by the Project (i.e., the Project footprint) during the life of mine and closure/post closure phases. Soil samples will also be collected from a non-impact control site for comparison. Metal concentrations in soil will be compared to CCME (2017) Soil Quality Guidelines, the Soil Criteria for Toxicity to Soil Invertebrates and Plants listed in the Contaminated Sites Regulation (BC Reg. 375/96) included in the BC *Environmental Management Act* (2003), and to baseline concentrations presented in the *Kemess Underground Project: Terrain and Soils Baseline Report* (Ardea Biological Consulting Ltd. 2015).

Soil samples will be collected from within the top 30 cm of soil pits, using a stainless steel hand-trowel at locations sampled during baseline programs. Samples will be sifted to remove stones and coarse fragments greater than 2 mm and stored in clean glass jars labelled with the unique plot number. Duplicate samples will be collected. Samples will be kept cool and sent under chain of custody to a suitably accredited laboratory for analysis within five days of collection or appropriate sample hold times (whichever is shorter).

Soil samples will be analyzed for a comprehensive suite of total metals with detection limits applicable for Agricultural and/or Residential/Parkland use standards (Table 5.2-1). Additional metals to analyze, which lack CCME Soil Quality Guidelines or Contaminated Sites Regulation Soil Criteria include: aluminum, bismuth, calcium, iron, lithium, magnesium, manganese, phosphorus, potassium, sodium, strontium, and titanium. Trace metals analysis in soil samples will be completed using Inductively Coupled Plasma Mass Spectrometry (ICPMS) methods.

Analysis of soil samples will also include pH and organic carbon content. Soil reaction (pH) analysis will help assess soil nutrient availability and potential metal mobility, while organic carbon content will help assess soil fertility.

<u>Timing of Soil Sampling</u>

Soil sampling will occur during the life of mine and during the closure/post closure phases. The frequency of soil sampling will be every three to five years to match the frequency of the Reclamation and Closure Plan (RCP) review/update.

Table 5.2-2. Canadian Soil Quality Guidelines and Contaminated Sites Regulation Soil Criteria

Metals	CCME Soil Quality Guideline [a] (mg/kg dw)	BC Contaminated Sites Regulation Soil Criteria for Toxicity to Soil Invertebrates and Plants [b] (mg/kg dw)
Antimony	20	-
Arsenic	12	50
Barium	500 [c]	1,000
Beryllium	4	-
Boron	2	-
Cadmium	1.4	70
Chromium	64	300
Cobalt	40	-
Copper	63	150
Lead	70	1,000
Mercury	6.6	100
Molybdenum	5	-
Nickel	45	-
Selenium	1	-
Silver	20	-
Thallium	1	-
Tin	5	-
Uranium	23	-
Vanadium	130	-
Zinc	200	450

Notes:
CCME = Canadian Council of Ministers of the Environment
dw = dry weight
(-) = not available
[a] CCME (2017). The lowest/most conservative soil criteria are shown in the table (for Agricultural use).
[b] Contaminated Sites Regulation (BC Reg. 375/96). The lowest/most conservative soil criteria are shown in the table (for Agricultural use).
[c] The CCME Soil Quality Guideline for barium for Residential/Parkland use is lower than that for Agricultural use (750 mg/kg dw), thus the lower and more conservative guideline for Residential/Parkland use is shown in the table.

5.2.3 Trace Metal Uptake in Vegetation

5.2.3.1 Objectives

The objective for ongoing monitoring of trace element concentrations in vegetation is to assess whether, as a result of mine activity, trace element concentrations increase over the baseline levels observed prior to KUG development and to investigate the suitability of vegetation for wildlife consumption. Currently, federal and provincial guidelines for metals in vegetation are not available; therefore, vegetation sampling for metal analysis will only be conducted if soil monitoring indicates increasing trends near or above soil quality guidelines.

Monitoring vegetation for metals will focus on areas disturbed by the Project (i.e., the Project footprint) and activities that expose soil and rock and/or produce dust. These areas include surficial blast sites, crusher area, conveyor system, haul roads, and tailings beach. Vegetation samples will also be collected from a non-impact control site for comparison.

The following considerations were taken into account when establishing the monitoring program:

- The likelihood of trace metal contamination decreasing with distance from the identified point sources; therefore, the initial sampling will be as close to sources as practical from safety and efficiency perspectives and to enable early detection of changes.
- The target vegetation species are not uniformly distributed in the project area, and it is likely that some will not occur within meaningful distance of potential contamination sources.
- The highest concentrations of trace metals will likely occur downwind and/or downstream of point sources, and sites oriented accordingly will be the priority for sampling (highest exposure context).
- Although the vegetation species identified as potential targets for monitoring were selected on the basis of their known or suspected use as forage for wildlife, it is unlikely that there will be much foraging at or near initial sample locations because of wildlife exclusion by human activity during all Project phases.

5.2.3.2 Methodology

Trace metal concentrations in vegetation will be monitored in samples collected from areas disturbed by the Project (i.e., the Project footprint) during the life of mine and closure/post closure phases. Metal concentrations in vegetation samples will be compared to baseline concentrations presented in the EAC Application.

Shrub samples should be collected as a composite from new growth of twigs and leaves from at least three locations on each plant. Sedge and herb samples should be collected as a composite of stems and leaves from each plant. Composite samples comprise clippings from five plants, distributed throughout the sample site to ensure that the minimum sample weight is collected. Although composite samples have lower variability than individual samples, the results are likely more representative of what would be consumed by browsing wildlife. Three replicate samples of each composite species should be collected at each sample site.

Vegetation sampling during the life of mine will include species growing in areas found to have (i) elevated soil metals, (ii) species used for progressive reclamation if reclaimed area has potential for ML/ARD, and (iii) species used on stockpiles that will be used for reclamation purposes.

Vegetation sampling during closure will include species growing in areas found to have (i) elevated soil metals, and (ii) species used for reclamation purposes in areas that have potential for ML/ARD.

If possible, foliar samples should be collected from vegetation species considered important forage species, such as:

- Water sedge (*Carex aquatilis*);
- Drummond's willow (*Salix drummondiana*);
- Grey-leaved willow (*Salix glauca*);
- Blueberry willow (*Salix myrtillifolia*);
- Tea-leaved willow (*Salix planifolia*);
- Mackenzie's willow (*Salix prolixa*);
- Balsam willow (*Salix pyrifolia*);
- Meadow horsetail (*Equisetum pratense*);
- Marsh cinquefoil (*Comarum palustre*); and
- Fireweed (*Epilobium angustifolium*).

Nitrile gloves will be worn during vegetation tissue collection. Vegetation for composite samples will be clipped directly into individually identified sample bags so that vegetation is not handled. All foreign debris will be removed prior to the sample being placed into a plastic sampling bag. Bags will be labelled with location, date, sample ID, and the species collected. A hand-held GPS will be used to record the location of each sample. Sample ID, species collected, date and time of collection, and location waypoint will be recorded on field forms. Ground Inspection forms (GIFs) will be completed for each new site, detailing the ecosystem, dominant vegetation, and water characteristics (e.g., level of flow, substrate type). All data will be entered into a spreadsheet for summary and analysis.

Vegetation samples will be kept frozen until delivery to a suitably accredited laboratory for analysis. Trace metals analysis of vegetation samples will be completed using ICPMS methods. As with the soil samples, vegetation samples will be analyzed for a comprehensive suite of 32 total metals (listed in Table 5.2-2 as well as aluminum, bismuth, calcium, iron, lithium, magnesium, manganese, phosphorus, potassium, sodium, strontium, and titanium). Metal concentrations in vegetation tissue will be analyzed using both dry and wet weights. Dry weight represents a relatively objective measure of metal concentration as it is independent of tissue moisture content, which can vary greatly over time. Thus, dry weight concentrations are the metal levels present in vegetation tissue irrespective of moisture status. However, wet weights are representative of wildlife foraging concentrations as vegetation is typically consumed fresh.

Data will be compiled and summarized (e.g., minimum, mean, median, maximum, standard deviation, and standard error) by sample site for each vegetation species and for species across all sites. For consideration, those data will be compared to baseline/previous results graphically and/or statistically, as considered appropriate, and implications will be discussed. Based on the results, appropriate management responses will be determined, including modifications to monitoring frequency, locations, and/or protocols. For example, statistically significant differences in concentrations over time at a sampling site may trigger increased monitoring.

Timing of Vegetation Sampling

If soil monitoring during the life of mine and during the closure/post closure phases indicates increasing trends near or above soil quality guidelines, then vegetation sampling will be triggered. The frequency of vegetation sampling will be the same as the soil sampling - every three to five years to match the frequency of the Reclamation and Closure Management Plan review/update.

Vegetation samples should be collected in the middle of July, close to the peak summer growth prior to seedset, and at the end of August when berries are ripe, if species with berries are targeted.

5.3 WETLANDS

Monitoring of potential effects and documentation of the implementation of mitigation measures relevant to wetland management will help determine if prescribed measures are achieving performance objectives. Monitoring programs will incorporate visual inspection for activities in the wetland that the discharge pipeline access corridor is constructed through formal hydrologic and vegetation monitoring described below.

5.3.1 Pre-Construction and Construction Monitoring

Prior to construction, the Attichika wetland that will be crossed by the discharge pipeline access corridor will be mapped to identify wetland extent.

Construction activities will be monitored under the direction of the Environmental Superintendent to ensure appropriate mitigation measures are identified and implemented. Construction-related disturbances will be mapped in the wetland with the coordination of flagging of construction boundaries, falling boundaries, riparian areas, and other sensitive areas to minimize disturbance to the wetland and ensure that where possible footprints are limited to existing KS disturbed areas.

5.3.2 Sediment and Erosion Control Monitoring

Sediment and erosion control features in and adjacent to the wetland will be monitored after high precipitation events and during runoff events until it is determined they are no longer required and may be removed. Monitoring will commence during construction and will continue until all areas are stabilized and successfully re-vegetated and pose no risk of sedimentation. Monitoring will be performed under the direction of the Environmental Superintendent.

5.3.3 Surface Water Monitoring

Surface water hydrology will be monitored in the Attichika wetland that is intersected by the discharge pipeline access corridor. To monitor potential changes in wetland hydrology, visual assessments will be conducted to identify if inundation or drying are noted. Drainage structures along the pipeline corridor will be inspected to ensure they are constructed and functioning properly and providing adequate flow of water through the corridor. Photos and notes will be taken to document any findings and will be included in annual reporting.

5.3.4 Vegetation Monitoring

To identify potential changes in plant species composition or abundance in the Attichika wetland related to the discharge pipeline access corridor, data on vegetation species types and cover will be gathered prior to and during Construction, and Operations. Invasive species will also be identified if present. The number of plots will be determined based on the heterogeneity of the vegetation community and the spatial extent of the disturbance footprint within the wetland. Changes in vegetation species, health, composition and cover will be used to determine if the pipeline might be affecting wetland vegetation. Permanent photo plots will be established in the wetland to provide photographic documentation of wetland conditions and vegetation communities in the wetland.

A visual assessment of the wetland will also be conducted to identify any changes in vegetation health (chlorotic vegetation or signs of inundation or desiccation) or changes in site conditions (e.g., ponding of water) outside of the plots. Photos and notes will be taken to document any findings and will be included in annual reporting.

5.3.5 Monitoring Schedule for Surface Water and Vegetation

All monitoring will occur in spring and fall for surface water and between June and September for three years. If after this time, no trends indicating detrimental effects to wetland hydrologic functions or plant species composition or abundance are observed, monitoring will cease. In the event that detrimental effects to wetland hydrologic functions or vegetation community are noted, monitoring will continue to determine the effectiveness of adaptive management measures implemented to restore wetland functions.

5.3.6 Analysis and Evaluation of Effects Associated with the Discharge Pipeline

The goal of wetland management is to limit effects to wetlands. To assess the effectiveness of mitigation and Project effects due to the construction and operation of the discharge pipeline, the monitoring results will be assessed against baseline monitoring targets, and triggers have been identified that if exceeded will result in adaptation of management and mitigation measures.

5.3.6.1 Assessing Discharge Pipeline Effects on Wetlands

Alteration of wetland conditions was predicted to affect up to 2.3 ha of the Willow - Sedge Fen wetland in the Attichika wetland complex within the EAC Application. Metrics have been identified to assess Project effects and the effectiveness of mitigation measures. The metrics and assessment processes that will be used to determine loss or alteration of wetland vegetation communities and hydrologic function are described below.

Loss of Wetland Extent

Loss of wetland extent will be characterized by the loss of wetland surface area that may occur under the maintenance road and pipeline footprint. Loss will be quantified as the difference between pre-construction vegetated wetland area versus post-construction vegetated area. This will be assessed after construction using a laser rangefinder, measuring tapes, or other suitable measuring devices.

Alteration of Wetland Conditions

Alteration of wetland conditions will be assessed by comparing vegetation community and wetland hydrology baseline data to monitoring data.

- Wetland vegetation conditions: monitoring results will be compared to the baseline vegetation conditions to identify if conditions have been altered. The cleared area will be measured to identify potential edge effects. Changes in vegetation conditions over time will be assessed using vegetation species baseline and monitoring data. Metrics will include calculations such as the ratio of shrub species to total species (to identify potential changes in structure), presence of invasive plant species, assessments of heterogeneity (Simpson's Index), and changes in obligate wetland species abundance. Based on the vegetation monitoring plots, plot photos, and baseline mapping; changes in vegetation communities, attributable to Project effects, will be mapped and the affected area calculated.
- Hydrologic conditions: monitoring results will be compared to baseline conditions to identify areas where changes in wetland hydrology may be occurring. Visual signs of drying or impoundment that may be occurring due to Project effects will be identified and measured using a GPS, laser rangefinder, measuring tapes, or other suitable measuring devices to determine the total area affected.

5.3.6.2 Triggers and Response

Loss

If loss of wetland extent exceeds 0.1 ha (the minimum area used in the EA to assess effects); a review of causes and potential mitigation will be initiated. Mitigation may include actions such reclamation of disturbed wetland areas using native wetland plant species.

Alteration

If the total area of wetland identified as altered due to Project effects either due to changes in wetland vegetation community or hydrologic changes exceeds 2.3 ha as identified in the EAC Application, an assessment of potential causes and appropriate mitigation measures will be conducted. Mitigation will be based on site specific causes but could include measures such as addressing altered hydrologic regimes by improving drainage, removing invasive plant species, or planting native wetland species in disturbed areas.

5.4 QUALITY ASSURANCE/QUALITY CONTROL

5.4.1 Vegetation

The process of data gathering in the field are quality controlled through the use of trained personnel and a system of pre- and post-field checks to ensure that consistent, repeatable data are being gathered. All personnel will have necessary training for the activities being conducted.

Quality assurance/quality control (QA/QC) measures for monitoring activities will be employed by:

- Following standard operating procedures (SOPs) during establishment of monitoring plots and subsequent re-measurement activities;
- Using standardized forms for data collection;
- Reviewing data entry for errors and following of accepted data analysis procedures; and
- Including a discussion in monitoring reports of any issues identified during QA/QC procedures and assessing the effectiveness of the plan and identifying adaptive management measures as required.

5.4.2 Trace Element Uptake

Quality assurance and quality control (QA/QC) procedures will be followed during soil and vegetation sampling for metal analysis. All persons collecting samples will be trained on appropriate sampling techniques to minimize the potential for cross-contamination and ensure that sample sizes are adequate for chemical analyses.

The precision and accuracy, representativeness, and sample holding times will be reviewed. Precision and accuracy will be controlled through an assessment of laboratory sample duplicate analysis. While the accredited laboratory will follow their own quality control procedures, the soil and vegetation sampling program will include sample duplicates (up to 5% of samples) to ensure the results are consistent. The laboratory's QA/QC procedures will include replicate testing (and calculation of relative percent difference) and instrument calibration verification. Sample results will not be released until all internal QA/QC data are acceptable.

5.5 NONCONFORMITY AND CORRECTIVE ACTION

A non-conformance is anything that occurs at the Project which is not in alignment with this management plan. If a non-conformity with the provisions of this management plan occurs or is identified the Environmental Superintendent will be informed. The Environmental Superintendent will be responsible for informing the appropriate parties, if required. The Environmental Superintendent will identify corrective measures to correct the non-conformity at earliest opportunity, and implement measures to prevent additional impacts and to prevent future nonconformities from occurring. If results of the trace metal uptake monitoring programs indicate that, as a result of mine activity, trace element concentrations increase over the baseline levels, the Environmental Superintendent will implement corrective and/or remedial actions. Consideration will be given to the standards for vegetation for wildlife consumption, but given this is a mineralized area, elevated metal concentrations are likely; therefore, monitoring against the change in baseline levels is of more importance.

5.6 INCIDENT IDENTIFICATION

AuRico will take all reasonable measures to prevent accidents and malfunctions that may result in adverse environmental effects. If emergency or spill incidents occur it will be reported per the requirements of the Emergency Response Plan, Environmental Spill Emergency Plan and Hazardous Materials Management Plan. AuRico employees and subcontractors are responsible for complying

with all environmental standards and regulations, including work site inspections and accident/incident investigations. Incident will be immediately investigated to determine the cause(s) and effective and immediate preventative and remedial action(s) will be developed.

6. REPORTING AND RECORD KEEPING

6.1 MONITORING REPORTING

Monitoring reporting procedures will be established during the Construction phase and carried through Operations and Closure. All personnel will be provided with information during Orientation to facilitate the reporting of any incident or concern during each phase of the Project. Personnel will be instructed to communicate any concerns including erosion and sediment production, windthrow, invasive plants, wetlands, and unauthorized access to restricted areas to the Environmental Superintendent.

Reporting will be subject to Environmental Assessment Certificate and *Mines Act* permit conditions. *Mines Act* (1996) reporting of environmental monitoring in the Annual Reclamation Report will include a description of the following, as applicable:

- The initial report after construction of the access corridor will describe the total area affected by construction, mitigation measures employed during construction, and identify the effectiveness of the measures. The report will recommend measures to be employed during Operations and required maintenance or additional monitoring activities that may be required based on observations during Construction;
- Planning and wetland management activities that illustrate coordination with other management plans such as the Surface Erosion Prevention and Sediment Control Plan, Invasive Plant Management Plan, Fish and Aquatic Effects Monitoring Plan, and Wildlife Management and Monitoring Plan;
- Measures employed to reduce impacts to wetlands to maintain hydrological connectivity and flow;
- Reporting on the hydrologic monitoring and an evaluation of the success of mitigation measures at maintaining hydrologic conditions;
- Reporting on the vegetation monitoring and an evaluation of the success of mitigation measures at maintaining vegetation community composition; and
- Proposed revisions to the Ecosystem Management Plan to identify changes or additional mitigation measures to address emerging negative trends, or to adjust monitoring programs, if required.

The Environmental Superintendent will be responsible for the implementation and monitoring of this Plan and for ensuring that the Performance Objectives are achieved and reported.

Should periods of temporary closure or care and maintenance occur, some monitoring will continue. The periodicity of reporting for the Closure and Post-closure phases will be determined prior to commencement of Closure.

6.2 ANNUAL REPORTING

Annual Reports will be subject to Environmental Assessment Certificate and *Mines Act* permit conditions. *Mines Act* (1996) reporting of environmental monitoring in the Annual Reclamation Report will include a description of the following, as applicable:

- Records of rare plants and lichen or invasive plants, monitoring undertaken where activities occur adjacent to identified sites, and reclamation activities will be summarized and available to report, with that year's completed data forms to be made available upon agency request. This information will be used as a means of tracking progress and determining future management activities;
- Planning and ecosystem management activities that illustrate coordination with other management plans such as the Surface Erosion Prevention and Sediment Control Plan, Fish and Aquatic Effects Monitoring Plan, and Wildlife Management and Monitoring Plan;
- Measures employed to reduce impacts to terrestrial ecosystems that depend on hydrological connectivity and flow (e.g., restoration of natural drainage following decommissioning of temporary access roads);
- Evaluation and rationale of whether the environmental protection measures were carried out according to the planned management for the site;
- Evaluation of the effectiveness of the environmental protection measure employed in achieving the stated objective(s); and
- Proposed revisions to the Ecosystem Management Plan to address emerging negative trends, or to adjust monitoring programs, if required.

The Environmental Superintendent will be responsible for the implementation and monitoring of this Plan and for ensuring that the Performance Objectives are achieved and reported.

Should periods of temporary closure or care and maintenance occur, some monitoring will continue. The periodicity of reporting for the Closure and Post-closure phases will be determined prior to commencement of Closure.

6.3 RECORD KEEPING

6.3.1 Monitoring Results

AuRico will maintain records of vegetation and wetland monitoring and results. This information will be collected using monitoring forms suitable for the Project. Data will be entered in a format and program that will allow for comparison between years. Monitoring data will be stored for the life of

mine. Monitoring will be performed under the direction of the Environmental Superintendent, who will ultimately be responsible for the development, implementation, and monitoring.

6.3.2 Continuous Improvement and Adaptive Management

Results from the vegetation and wetland monitoring programs will be reviewed to determine if any trends are evident and if objectives are being met. The need for any corrective actions to reduce negative effects to soils, vegetation, ecosystems, site hydrology or vegetation communities will be determined on a case-by-case basis. Indications of the need for corrective action or additional control measures may include monitoring data showing an increasing negative trend (e.g., considerable changes to wetland extent or function, sedimentation in fish bearing streams).

The monitoring data will also be used to provide feedback to modify any management and monitoring procedures incorporated at the site, as required. Measures described in the Ecosystem Management Plan apply to all Project components for the life of the Project, unless otherwise indicated. Components of the Ecosystem Management Plan may need to be revised over the life of the Project, based on regulatory changes and/or technological advances.

7. QUALIFIED PROFESSIONALS

Under the direction of AuRico Metals Inc., a team of consultants have supported preparation of this management plan. This management plan has been prepared and reviewed by, or under the direct supervision of, the following Qualified Professionals:

Sections 5.2.2 and 5.2.3 (Trace Metal Uptake in Soils and Vegetation) prepared by:

<original signed by>

Cara Lachmuth, M.Sc., R.P.Bio
ERM Consultants Canada Ltd.

Reviewed by:

<original signed by>

Jordan Evans, M.Sc., P.Ag, R.P.Bio
AuRico Metals Inc.

Sections 4.2 and 5.3 (Wetlands) prepared by:

<original signed by>

Ben Andrew, RPF
B.A. Blackwell and Associates Ltd.

Reviewed by:

<original signed by>

Jordan Evans, M.Sc., P.Ag, R.P.Bio
AuRico Metals Inc.

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APPENDIX B

Kemess Underground Project: Human Health Follow-Up Program

KEMESS UNDERGROUND PROJECT

Human Health Follow-up Program

Version: 2.0

Date: June 2020

AuRico Metals Inc.
110 Yonge Street, Suite 601
Toronto, ON
Canada M5C 1T4
T: (416) 216-2780
F: (416) 216-2781

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Human Health Follow-up Program

TABLE OF CONTENTS

LIST OF FIGURES

GLOSSARY AND ABBREVIATIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Agency, the	The Canadian Environmental Assessment Agency
AQMP	Air Quality Monitoring Plan
BC	British Columbia
BC MOE	British Columbia Ministry of Environment & Climate Change Strategy
CCME	Canadian Council of Ministers of the Environment
COPC	Contaminant of potential concern
CSF	Cancer slope factor
EAC	Environmental Assessment Certificate
EDI	Estimated daily intake
EEM	Environmental Effects Monitoring
ELDE	Estimated lifetime daily exposure
EMP	Ecosystem Management Plan
FAEMP	Fish and Aquatic Effects Monitoring Plan
FDMP	Fugitive Dust Monitoring Plan
HHFP	Human health follow-up program
HHRA	Human health risk assessment
HQ	Hazard quotient
IBA	Impact Benefits Agreement
ILCR	Incremental lifetime cancer risk
km	Kilometre
KUG	Kemess Underground Project
MA/EMA	*Mines Act/Environmental Management Act*
ML/ARD	Metal leaching/acid rock drainage

MSWMP	Mine Site Water Management Plan
ORAR	Omineca Resource Access Road
Project, the	The Kemess Underground Project
RPD	Relative percent difference
SeMP	Selenium Management Plan
SOP	Standard operating procedure
TKN	Tse Keh Nay
TRV	Toxicity reference value
TSF	Tailings Storage Facility
ww	Wet weight

1. INTRODUCTION

The Canadian Environmental Assessment Agency (the Agency) conducted an environmental assessment of the Kemess Underground Project (KUG; the Project) pursuant to the *Canadian Environmental Assessment Act, 2012* and *the Memorandum of Understanding between the Canadian Environmental Assessment Agency and the B.C. Environmental Assessment Office on the Substitution of Environmental Assessments* (2013). A positive Decision Statement was issued by the Agency on March 9, 2017, with conditions (CEAA 2017). Condition 5 relates to Human Health:

> ***5.1.*** *The Proponent shall develop, prior to construction and in consultation with Indigenous groups and relevant authorities, a follow-up program to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples caused by changes in concentrations of contaminants of potential concern identified during the environmental assessment in air, soil, water, and sediment. The Proponent shall implement the follow-up program during construction and operation. As part of the development of the follow-up program, the Proponent shall:*
>
> > ***5.1.1.*** *identify levels of environmental change relative to established baseline conditions for contaminants of potential concern that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health; and*
> >
> > ***5.1.2.*** *if monitoring results demonstrate that concentration levels for contaminants of potential concern are greater than the identified levels of environmental change, update the human health risk assessment for the consumption of traditional foods exposed to these contaminants and communicate the results of the updated human health risk assessment to Indigenous groups.*

This document describes the Human Health Follow-up Program (HHFP) to address the above condition.

1.1 PURPOSE AND OBJECTIVES

The purpose of the HHFP is to mitigate potential adverse effects on the health of Indigenous Peoples as a result of the Project. Objectives of the HHFP are to:

1. Enable the Proponent to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples caused by changes in concentrations of contaminants of potential concern (COPCs) identified during the environmental assessment.
2. Identify levels of environmental change relative to established baseline conditions for COPC that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health.

As per Condition 5.1.2, mitigation measures may include an update to the human health risk assessment (HHRA) for the consumption of traditional foods exposed to contaminants exceeding identified levels of environmental change. Thus, a country foods risk assessment is one of the endpoints for the HHFP. Focusing a risk assessment to country foods is justified because food ingestion can be a significant pathway of exposure in humans to contaminants, contaminants can bioaccumulate in the food chain, and animal food (meat or fish) can migrate from high-exposure

locations to traditional hunting/fishing areas distant from Project sites, where exposure pathways to Project-related contaminants in air and water are much less significant.

The HHFP contains the following components:

- a review of the COPCs identified for baseline and Project phases;
- a summary or relevant monitoring commitments contained in other Project monitoring and management plans, specifically:
  - Mine Site Water Management Plan (MSWMP),
  - Fish and Aquatic Effects Monitoring Plan (FAEMP),
  - Selenium Management Plan (SeMP), and
  - Ecosystem Management Plan (EMP);
- a sampling plan for supplemental sampling of environmental media necessary for country foods monitoring that are not covered under other monitoring plans;
- identification of levels of environmental change relative to baseline conditions in media that would require the Proponent to implement modified or additional mitigation measure(s) to mitigate increased risks to human health;
- an outline of the country foods risk assessment steps;
- methodology for the derivation of hazard quotients (HQs) and incremental lifetime cancer risks (ILCRs); and
- a data management and reporting framework.

There is limited use of the KUG mine site area by Indigenous peoples and AuRico Metals Inc. (acquired by Centerra Gold Inc.) has agreed to an area of restricted access ("exclusion area") around the mine site through their Impact Benefits Agreement (IBA). The IBA for the Project was established between AuRico Metals Inc. and the Tse Keh Nay (TKN) First Nations in May 2017. The TKN is an alliance of the Takla Lake First Nation, the Tsay Keh Dene Nation, and Kwadacha Nation. Thus, the HHFP is another layer of measures to avoid impacting the health of Indigenous peoples.

1.2 GENERAL APPROACH

As indicated in Condition 5.1, the objective of the HHFP for the Project is to 1) verify the accuracy of the environmental assessment and to 2) identify levels of environmental change at which modified or additional mitigation measure(s), including an update of the country foods risk assessment, to mitigate increased risks to human health may be implemented. The country foods evaluated in the Project's Application for an Environmental Assessment Certificate (EAC Application; AuRico 2016) were:

- berries: crowberry and soapberry (measured COPC tissue concentrations);
- freshwater fish: Bull Trout, Dolly Varden, Whitefish, and Rainbow Trout (measured COPC tissue concentrations);
- moose (COPC tissue concentrations calculated with a food chain model);

- snowshoe hare (COPC tissue concentrations calculated with a food chain model); and
- ruffed grouse (COPC tissue concentrations calculated with a food chain model).

The calculation of COPC tissue concentrations for moose, snowshoe hare, and ruffed grouse using a food chain model (Golder Associates Ltd. 2005) requires the input of measured COPC concentrations in surface water, soil, and diet items (i.e., vegetation). Thus, the environmental media data that would be required for an updated HHRA for country foods includes: surface water, soil, fish tissue, and vegetation tissue (berries for human consumption and vegetation diet items for moose, hare, and grouse) COPC concentrations.

Monitoring of air quality (i.e., dustfall levels and metals in dustfall) is not required for the HHFP as potential COPCs from the Project through atmospheric deposition will be addressed with the monitoring of metal concentrations in soil and vegetation samples. Monitoring of other parameters in air under the HHFP is not required by Condition 5 as criteria air contaminants (CACs), such as NO_2 or particulate matter, were not COPCs in the original EAC Application (i.e., did not meet the criteria to be considered COPCs, see Section 18.5.2.2 of the EAC Application). However, monitoring of some air quality parameters (including NO_2, SO_2, and particulate matter) is included in the Air Quality Monitoring Plan (AQMP; AuRico 2020a) and in the Fugitive Dust Monitoring Plan (FDMP; AuRico 2020c). Results of monitoring under the AQMP will be considered in reporting under the HHFP (Section 8) if exceedances of applicable objectives or standards for these parameters are identified in the AQMP or the FDMP.

Monitoring of relevant environmental media (i.e., surface water, sediment, soil, vegetation, fish tissue) is described in a series of other monitoring and management plans developed for the Project. It is assumed that if there is no change in these environmental media, the quality of country foods will not change and will not require an update to the risk assessment. Therefore, the HHFP relies on commitments and results from the other monitoring plans developed for the Project. Where warranted, the HHFP includes supplemental sampling specifically designed to meet the objectives of the HHFP and needs of a potential future update to the country foods risk assessment. The general adaptive management structure of the HHFP is as follows:

1. Monitoring of surface water, sediment, soil, vegetation, and fish tissues as per the MSWMP, FAEMP, SeMP, and EMP.
2. Should soil or vegetation sampling within the Project footprint under the existing Ecosystem Management Plan indicate increasing COPC concentrations (i.e., above soil metal or vegetation metal concentrations predicted in the EAC Application), additional soil and vegetation samples will be collected from outside of the Project footprint that are accessible to potential country foods consumers (i.e., supplemental sampling).
3. If levels of environmental change (defined in Section 5) are exceeded in environmental media, the combined environmental media sampling results will be used to update the HHRA for country foods and/or will trigger adaptive management actions described in other management plans, such as:
   - alteration of drainage pathways, re-evaluation of the water balance and water quality model, diversion of non-contact water, water treatment options, and re-evaluation of discharge limits (discussed in Sections 5 and 8 of the MSWMP; AuRico 2017c);

- initiation of additional fish and aquatic habitat Adaptive Management Monitoring Programs and control charting using control datasets (discussed in Section 8.3.7 of the FAEMP; AuRico 2017a);
- corrective actions to lower selenium concentrations in the environment (discussed in Section 8 of the SeMP; AuRico 2017d); and
- corrective action or additional control measures to reduce negative effects to soils and vegetation (discussed in Section 6.3.2 of the EMP; AuRico 2020b).

4. The results and uncertainties of the updated HHRA for country foods will be compared to established baseline and predicted Project results to verify the accuracy of the environmental assessment as it pertains to adverse effects on the health of Indigenous Peoples and to indicate whether an increased risk to consumers of country foods exists due to Project activities.
5. Adaptive management/mitigation measures will be reviewed and additional measures will be considered if a significant increase in risk to consumers of country foods due to Project activities is identified.

This phased approach will provide an integrated approach with other ongoing monitoring programs within the Project area, maintains monitoring techniques of historical data collection approaches to allow comparability with previous and ongoing sampling in the Project area, and addresses the requirements of federal HHRA guidelines.

1.3 APPLICABLE GUIDANCE

The HHRA methodology is based on Health Canada's guidelines for HHRAs and environmental assessments (Health Canada 2010a, 2010e, 2010d), which were used in the original EAC Application. Health Canada (2007) also provides a management strategy to reduce the risk of unacceptable exposures to mercury from fish consumption, which is also considered.

2. REVIEW OF CONTAMINANTS OF POTENTIAL CONCERN

The EAC Application (AuRico 2016) identified COPCs for human health under established baseline and predicted Project conditions (i.e., the Construction and Operations phases). Specific contaminants were selected as COPCs if they met at least one of the following five screening criteria:

1. The concentration of metals bound to PM_{10} exceeded (or were predicted to exceed) the Texas Commission on Environmental Quality Effects Screening Levels (Texas CEQ 2014) and the Ontario Ministry of the Environment Ambient Air Quality Criteria (Ontario MOE 2012). However, this COPC screening only applies to the inhalation pathway, which is not considered in the HHFP, as it is of lesser significance than the country foods ingestion pathway.
2. The maximum metal concentrations in soil samples considered in the assessment exceeded (or were predicted to exceed) the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for Agricultural Land Use (CCME 2013).

3. The maximum metal concentrations in surface water exceeded (or were predicted to exceed) the British Columbia Ministry of Environment and Climate Change (BC MOE) Water Quality Criteria for the drinking water supply or Health Canada Guidelines for Canadian Drinking Water Quality, whichever guideline was lower (BC MOE 2015; Health Canada 2015). However, this COPC screening only applies to the drinking water pathway, which is not considered in the HHFP, as it is of lesser significance than the country foods ingestion pathway.
4. Fish tissue metal concentrations considered in the assessment exceeded (or were predicted to exceed) the fish tissue residue guidelines for mercury and selenium:
    a. The BC MOE (Beatty and Russo 2014) screening value of 1.83 mg selenium/kg wet weight (ww) for a high fish consumption rate of >220 g/day.
    b. The Health Canada fish tissue consumption guideline of 0.5 mg mercury/kg ww (Health Canada 2013).
5. Metals that have a potential to bioaccumulate in organisms or biomagnify in food webs, such that there could be significant transfer of the metal from soil to plants and subsequently into higher trophic levels even at concentrations lower than guidelines. These metals include: arsenic, cadmium, lead, mercury, nickel, selenium, thallium, and zinc.

The Joint *Mines Act/Environmental Management Act* (MA/EMA) Permit Application (AuRico 2017b) also evaluated potential changes in COPCs for human health due to updates to air and water quality modelling associated with waste discharge authorizations for the Project. However, no new COPCs were identified during the Joint MA/EMA Permit Application process, thus it is not discussed further. The results of the COPC selection process for the EAC Application are summarized in Sections 2.1 to 2.3; however, the discussion is limited to the COPC screening applicable to country foods (e.g., does not discuss results of screening metals bound to PM_{10}).

2.1 CONTAMINANTS OF POTENTIAL CONCERN IDENTIFIED FOR HUMAN HEALTH UNDER BASELINE CONDITIONS IN THE ENVIRONMENTAL ASSESSMENT

No CACs were identified as COPCs in the baseline air quality screening (see Section 4.4.1 and Table 4.4-1 of Appendix 18-A of the EAC Application; AuRico 2016).

The COPCs identified in the baseline soil quality screening (see Section 4.5 and Table 4.5-1 of Appendix 18-A of the EAC Application; AuRico 2016) were: arsenic, barium, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, vanadium, and zinc.

The COPCs identified in the baseline surface water quality screening (see Sections 4.6.1 and 4.6.2, Tables 4.6-1 and 4.6-2 of Appendix 18-A of the EAC Application using drinking water quality guidelines; AuRico 2016) were: dissolved and total aluminum, cadmium, iron, lead, manganese, nitrate, selenium, and sulphate. However, iron was not retained as a COPC as it is an essential element for humans and since environmental exposure to iron from food consumption (the largest source of exposure) is not likely lead to adverse health effects. Furthermore, iron is considered an innocuous substance by Health Canada (2010c).

The COPCs identified in the baseline fish tissue concentrations (see Section 4.7.1.2 and Appendix A of Appendix 18 A of the EAC Application; AuRico 2016) were mercury and selenium.

Thus, with the addition of bioaccumulative contaminants, the COPCs selected for the baseline HHRA included: aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate (water only), selenium, sulphate (water only), thallium, vanadium, and zinc.

2.2 CONTAMINANTS OF POTENTIAL CONCERN IDENTIFIED FOR HUMAN HEALTH UNDER PROJECT-RELATED CONDITIONS IN THE ENVIRONMENTAL ASSESSMENT

No CACs were identified as COPCs during the Construction or Operations phases based on screening of air quality predictions (see Section 3.3.1 and Table 3.3-1 of Appendix 18-B of the EAC Application; AuRico 2016).

The soil quality selection identified the following COPCs during the Construction and Operations phases (see Section 3.4 and Table 3.4-2 of Appendix 18-B of the EAC Application; AuRico 2016): arsenic, barium, boron, cadmium, chromium, copper, lead, molybdenum, nickel, selenium, vanadium, and zinc.

The following non-metal COPCs in surface water were screened in (against Canadian Drinking Water Quality Guidelines) during both the Construction and Operations phases (see Section 3.5.1 and Table 3.5-1 of Appendix 18-B of the EAC Application; AuRico 2016): nitrate and sulphate. The surface water quality COPC screening (against Canadian Drinking Water Quality Guidelines) identified the following metal COPCs during both the Construction and Operations phases (see Section 3.5.2 and Table 3.5-2 of Appendix 18-B of the EAC Application; AuRico 2016): total and dissolved aluminum, cadmium, iron, lead, manganese, and selenium. Consistent with the baseline HHRA (Section 4.8 of Appendix 18-A of the EAC Application; AuRico 2016), iron was not retained as a COPC.

Fish tissue selection identified selenium as a COPC during both the Construction and Operations phases (see Section 3.6.1 and Tables 3.6-1 and 3.6-2 of Appendix 18-B of the EAC Application; AuRico 2016).

Thus, with the addition of bioaccumulative contaminants, the COPCs selected for the Project-related HHRA include: aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate (water only), selenium, sulphate (water only), thallium, vanadium, and zinc. These COPCs are the same as those selected in the baseline HHRA (Appendix 18-A of the EAC Application; AuRico 2016).

There were no COPCs identified from road dust (Section 3.7 of Appendix 18-B of the EAC Application; AuRico 2016).

2.3 OVERALL LIST OF CONTAMINANTS OF POTENTIAL CONCERN IDENTIFIED FOR HUMAN HEALTH

The overall list of COPCs identified for human health during the EAC Application (AuRico 2016) were: **aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate (water only), selenium, sulphate (water only), thallium, vanadium,** and **zinc**. This list of COPCs is proposed for monitoring in environmental media.

3. RELEVANT MONITORING AND MANAGEMENT PLANS

A series of management and monitoring plans have been developed for the Project. Many of these plans outline monitoring commitments relevant to the HHFP objectives. The HHFP relies on the monitoring and associated results from several of the plans, as described below.

3.1 MINE SITE WATER MANAGEMENT PLAN

Section 6.1.2 of the MSWMP (AuRico 2017c) describes the surface water monitoring in the receiving environment that will be conducted for the Project.

Surface water quality monitoring sites and monitoring frequency under the MSWMP (AuRico 2017c) build on monitoring sites identified in the FAEMP (AuRico 2017a) and have been designed to incorporate the monitoring required under existing permits. Further, the components of the monitoring program are intended to provide sufficient spatial and temporal coverage to collect representative data from the most relevant locations (e.g., downstream of the Project) and time periods (e.g., open water or low flow periods). As applicable, sample and data collection for the separate components of the MSWMP and FAEMP will be coordinated to ensure data are cotemporaneous, which reduces the potential for confounding factors in subsequent analyses.

Surface water quality locations monitored during Construction and Operations phases under the MSWMP include 6 of the 14 surface water quality model node locations (i.e., KN-11b, WQ-01, WQ-14F, WQ-17, WQ-18, and Thutade Lake) that were used in the HHRA presented in the EAC Application (see Section 4.6 of Appendix 18-A). Thus, for the HHFP, water quality samples obtained from these six monitoring locations shown on Figure 4-1 can be compared to the baseline and predicted Project water quality presented in the EAC Application and the Joint MA/EMA Permit Application.

Stream water quality samples will be collected monthly (12 times per year) during pre-Construction, Construction, and Operations, except for sampling at the far-field monitoring site (Thutade Lake), which will be sampled quarterly. The timing of quarterly sampling is designed to capture representative periods during winter low-flow conditions, freshet, summer low flow, and the increased stream flows in fall.

3.2 FISH AND AQUATIC EFFECTS MONITORING PLAN

Monitoring of aquatic resources (i.e., fish, periphyton, and benthic invertebrate communities, and sediment quality) under the FAEMP (AuRico 2017a) will begin during the first year of Construction. There are three sampling locations for aquatic resources proposed under the FAEMP (shown in Figure 4-1): EEM-18 (equivalent to WQ-18), ATT-DIS, and EEM-13 (equivalent to WQ-13).

The monitoring program will occur every few years over a seven-year period, with infill years of slightly reduced monitoring requirements. Kemess South aquatic monitoring plans include: the Provincial Environmental Effects Monitoring (EEM) in Kemess Creek; selenium reporting in Waste Rock Creek; long-term fish monitoring in Attichika/Kemess creeks; and the Federal EEM in Kemess Creek. The KUG aquatic monitoring plan includes: discharge monitoring and adaptive management in Attichika Creek, Waste Rock Creek and the Northern Project Area; and the Federal EEM in Attichika Creek.

As described in Section 8.3.7.2 of the FAEMP (AuRico 2017a), surface water quality in Amazay Lake (which is 1 of the 14 surface water quality model node locations used in the HHRA presented in the EAC Application) will be monitored during the early Construction phase. Thus, water quality samples obtained under the Amazay Lake monitoring component of the FAEMP can also be applied in the HHFP.

Fish monitoring studies are described in Section 8.3.5.7 of the FAEMP (AuRico 2017a). As part of the Adult Fish Monitoring Study, annual non-lethal fish tissue monitoring of adfluvial Bull Trout from Thutade Lake will be conducted. This study will monitor contaminants that can bioaccumulate within fish species, including mercury, and focus specifically on Bull Trout in Thutade Lake, given this population's importance as a food source for Indigenous groups in the area. Sampling will be conducted at three locations in Attichika Creek (Thutade Lake Bull Trout migrate up Attichika Creek to reach spawning habitats), similar to baseline studies presented in Hatfield and Bustard (2015). A target of eight fish will be captured by angling and will be sampled non-lethally using dermal tissue punches. Monitoring will be conducted on an ecologically relevant timeline and will match previous baseline sampling and other ongoing monitoring activities to maximize comparability of data over time.

Biological monitoring in Amazay Lake will only be implemented when routine water quality monitoring from the Amazay Lake Monitoring Plan initiates a trigger response (outlined in Section 8.3.7.1 of the FAEMP). In addition, biological sampling is also proposed in Amazay Lake during the early Construction phase years (either fall 2018 or 2019) as an adaptive management approach and to update baseline information for this lake. Proposed sampling includes Rainbow Trout tissue metal analysis because they are the most abundant fish species in the Lake. Thus, if fish tissue sampling is triggered or fish is collected as an adaptive management approach, samples will also be used in the HHFP.

3.3 SELENIUM MANAGEMENT PLAN

Section 6.1.2 of the SeMP (AuRico 2017d) describes the surface water and sediment monitoring in Waste Rock Creek that will be conducted for the Project. Monitoring will be conducted in accordance with permit PE15335, with sample sites and frequencies specified in the permit.

Section 6.5 of the SeMP (AuRico 2017d) describes the proposed fish tissue sampling. A very small population of adult fish is present in Waste Rock Creek; thus, alternate locations such as the Attichika

wetlands will be considered for an annual lethal fish survey. Methodology for fish tissue sampling is provided in the FAEMP (AuRico 2017a). Fish tissue will be analyzed for a full suite of metals.

Surface water quality data, sediment quality data, and fish tissue metal data obtained via monitoring under the SeMP will be used in the HHFP. Should an update of the HHRA for country foods be required, fish tissue monitoring data will be incorporated into the risk assessment for consumers of fish.

3.4 ECOSYSTEM MANAGEMENT PLAN

Sections 5.2.2 and 5.2.3 of the EMP (AuRico 2020b) describes the monitoring for trace metal uptake in soil and vegetation that will be conducted for the Project. Under the EMP, vegetation sampling for metals analysis will be co-located with soil sampling, and vegetation samples will be collected with each soil sample (provided relevant vegetation species are present at the sampling site).

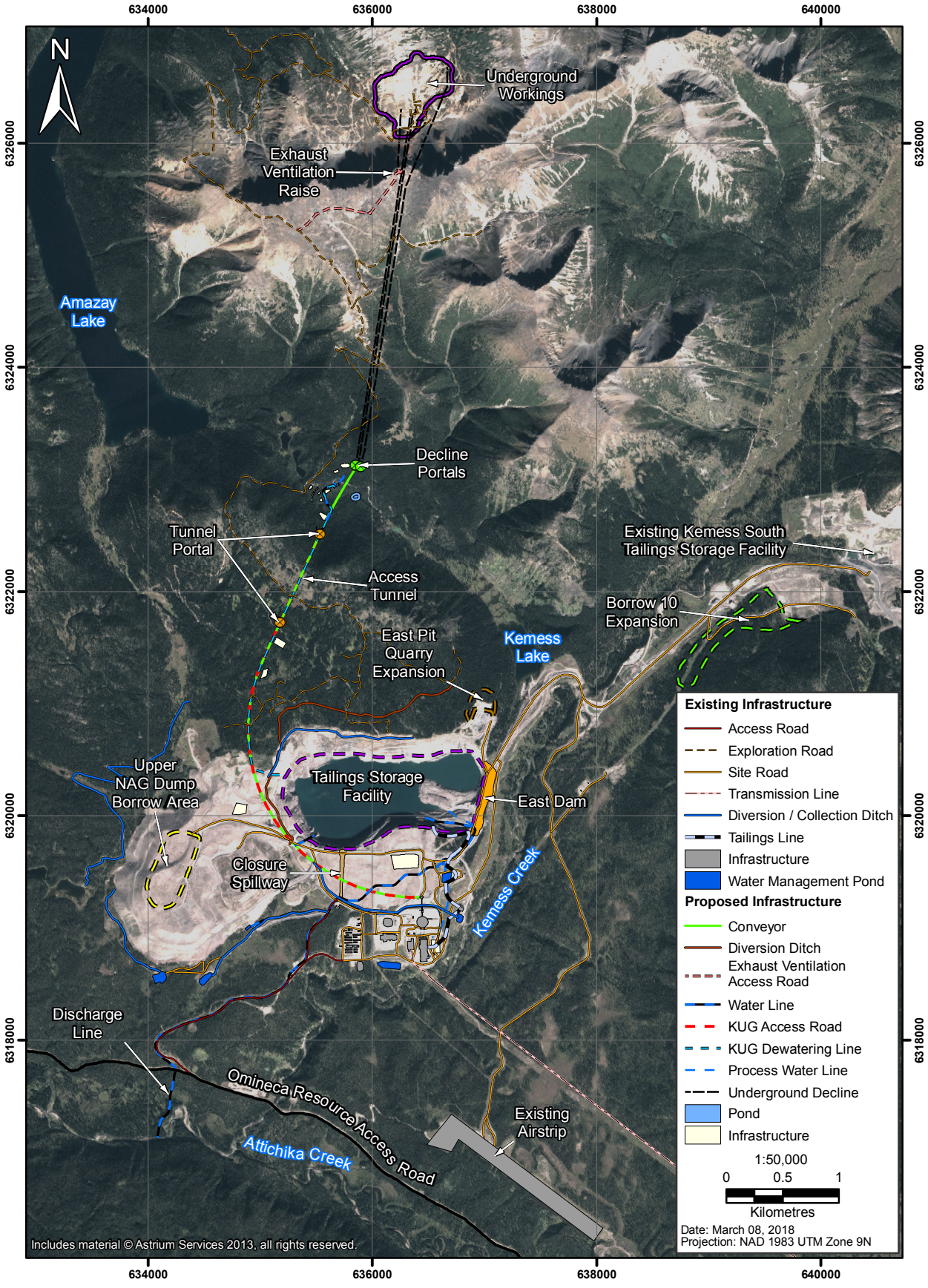
Trace metal concentrations in soil and vegetation will be monitored in samples collected from areas disturbed by the Project (i.e., the Project footprint; Figure 3-1) during the life of mine. Soil and vegetation samples will also be collected from a non-impact control site for comparison. The non-impact control site will be identified at the time of sampling based on accessibility; the preferred location based on air quality modelling is southwest of the mine site, at least 1 km south of the access road.

The frequency of soil and vegetation sampling will be every three to five years to match the frequency of the Reclamation and Closure Plan review/update.

Vegetation sampling will include species identified as country foods and important forage species for wildlife. Vegetation species identified as country foods or important forage species for wildlife include the following:

- Crowberry (*Empetrum nigrum*);
- Soapberry (*Shepherdia canadensis*);
- Water sedge (*Carex aquatilis*);
- Drummond's willow (*Salix drummondiana*);
- Grey-leaved willow (*Salix glauca*);
- Blueberry willow (*Salix myrtillifolia*);
- Tea-leaved willow (*Salix planifolia*);
- Mackenzie's willow (*Salix prolixa*);
- Balsam willow (*Salix pyrifolia*);
- Meadow horsetail (*Equisetum pratense*);
- Marsh cinquefoil (*Comarum palustre*); and
- Fireweed (*Epilobium angustifolium*).

Figure 3-1
Project Footprint



Vegetation samples will be collected in the middle of July, close to the peak summer growth prior to seedset, or at the end of August when berries are ripe. Shrub samples should be collected as a composite from new growth of twigs and leaves from at least three locations on each plant. Sedge and herb samples should be collected as a composite of stems and leaves from each plant. Berries from fruiting shrubs will be collected separately from other plant parts. Composite samples are comprised of clippings from five plants, distributed throughout the sample site, to ensure that the minimum sample weight is collected. Although composite samples have lower variability than individual samples, the results are likely more representative of what would be consumed by browsing wildlife or by humans. Three replicate samples of each composite species should be collected at each sample site.

Soil samples will be analyzed for a comprehensive suite of total metals with detection limits applicable for Agricultural and/or Residential/Parkland use standards. Vegetation samples will be analyzed for a full suite of metals.

4. SAMPLING PLAN

The monitoring locations of environmental media required for the HHFP are shown in Figure 4-1.

4.1 WATER

All of the COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, nitrate, selenium, sulphate, thallium, vanadium, and zinc; see Section 3.1) are included in the environmental monitoring programs for water quality under the MSWMP (AuRico 2017c), FAEMP (AuRico 2017a), and SeMP (AuRico 2017d).

Surface water quality monitoring locations that will be used for the HHFP (i.e., KN-11b, WQ-01, WQ-14F, WQ-17, WQ-18, Thutade Lake, and Amazay Lake) are shown on Figure 4-1. The water quality monitoring locations and frequency of monitoring described in the MSWMP (AuRico 2017c), FAEMP (AuRico 2017a), and SeMP (AuRico 2017d) are considered to be sufficient to identify levels of environmental change (described in Section 5.1) for the HHFP. These sites were included in the HHRAs in the EAC Application and are located downstream of the Project in areas where Project-related changes in water quality are most likely to occur, and sampling is already proposed on a regular (monthly or quarterly) basis. Thus, supplemental surface water quality monitoring under the HHFP is not proposed.

4.2 SEDIMENT

All of the COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc), except for those that only apply to surface water, are proposed for monitoring in sediment under the FAEMP and/or other aquatic monitoring programs ongoing in the Kemess Area (Section 3.2).

Sediment quality sampling locations that will be used for the HHFP are shown on Figure 4-1. The monitoring locations and frequency of monitoring for sediment described in the FAEMP (AuRico 2017a) and SeMP (AuRico 2017d) are considered to be sufficient to identify levels of environmental

change (described in Section 5.2) for the HHFP. These locations are downstream of the Project in areas where changes in sediment are most likely to occur and potential changes in sediment concentrations of COPCs typically occur over longer time periods. Thus, supplemental sediment quality monitoring under the HHFP is not proposed.

4.3 FISH

All of the COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc), except for those that only apply to surface water, are proposed for monitoring under the FAEMP Adult Fish Monitoring Study (Section 3.2) and/or the SeMP (Section 3.3).

Exact locations for fish tissue sampling under the SeMP are currently unknown (potential locations include the Attichika wetlands). Fish tissue sampling locations under the FAEMP are shown on Figure 4.-1. The monitoring locations and frequency of monitoring for fish tissue metals described in the FAEMP (AuRico 2017a) and SeMP (AuRico 2017d) are considered sufficient for fish metal characterization for a potential country foods risk assessment. The sampling sites are located downstream of the Project in areas where changes in tissue concentrations are most likely to occur and where fish populations may support ongoing sampling efforts. Thus, supplemental fish tissue sampling under the HHFP is not proposed.

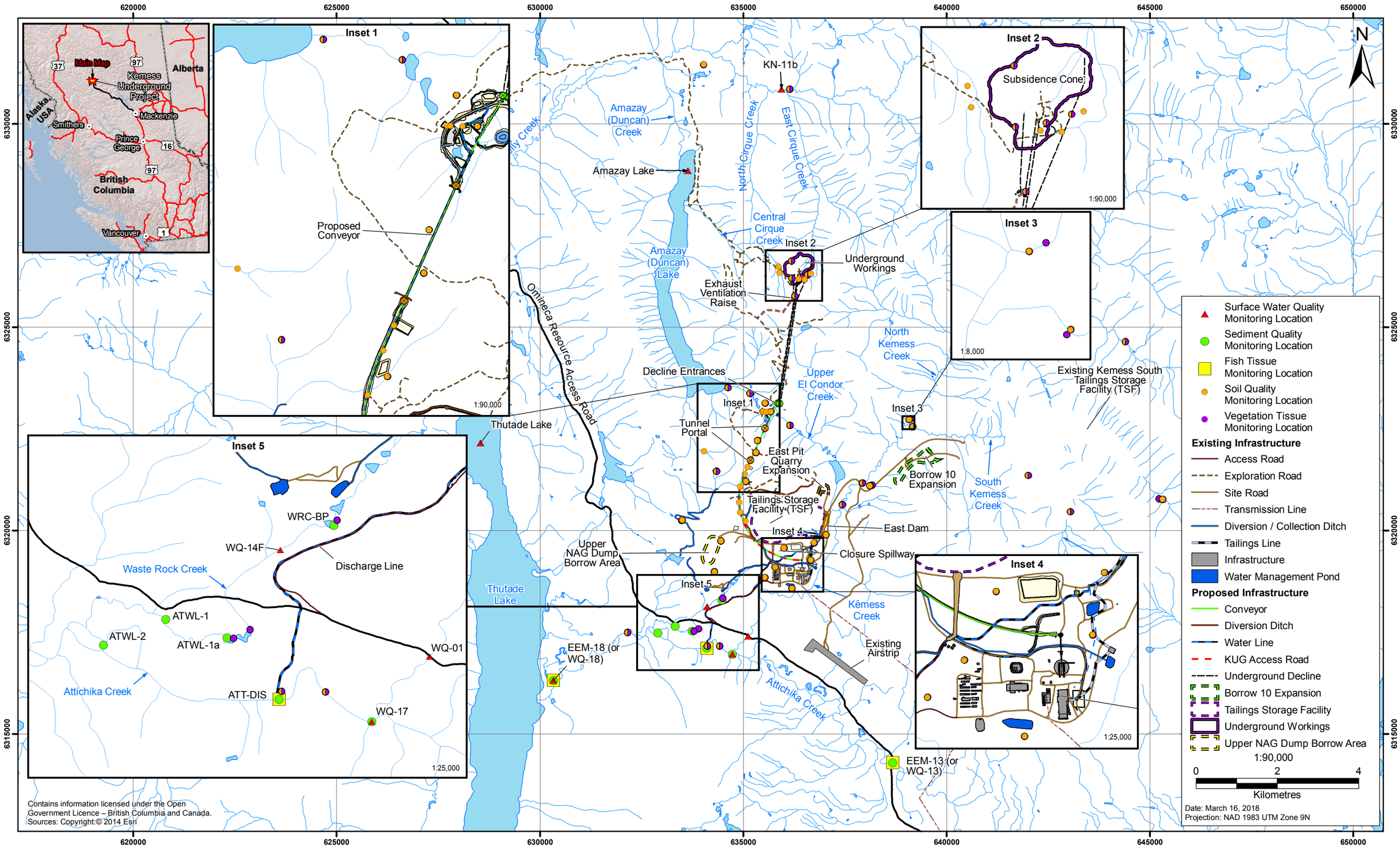
Inclusion of methylmercury analysis may be considered; however, sample volumes may be too small to allow inclusions (i.e., dermal punch samples). In the event that methylmercury analysis cannot be done, it will be assumed that 100% of the mercury measured in fish tissue is in the methylmercury form, consistent with the approach used in Appendix 18-A and 18-B of the EAC Application (AuRico 2016).

4.4 SOIL AND VEGETATION

Soil and vegetation monitoring done under the EMP (Section 3.4 and AuRico 2020b) will be considered in the HHFP. Soil and vegetation sampling sites will be co-located and samples of both soil and vegetation will be collected at the same time at each site (provided relevant vegetation species are present at the sampling site). The COPCs listed in Section 2.3 (i.e., aluminum, arsenic, barium, boron, cadmium, chromium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc), except for those that only apply to surface water, are included in the analysis planned under the EMP.

The sampling locations and frequency (every three to five years) of monitoring for soil and vegetation metal concentrations described in the EMP (Section 3.4 and AuRico 2020b) are considered to be sufficient as a starting point to identify levels of environmental change (described in Section 5.3) for soil and vegetation within the Project footprint. These sites within the Project footprint were selected because they are closest to the Project-derived sources of dust and are in the most likely areas to experience the greatest changes in soil or vegetation metal concentrations. The predicted changes in soil and vegetation metal concentrations during Construction and Operations were small (Table 3.4-2, 4.6-1 and 4.6-2 of Appendix 18-B of the EAC Application; AuRico 2016) and potential changes to soil or vegetation tissue metals were predicted to occur over a long time horizon (e.g., several decades). Therefore, initially sampling every three to five years is considered sufficient for the protection of human health.

Figure 4-1
Environmental Media Monitoring Locations for the Human Health Follow-up Program



However, if sampling under the EMP identifies that COPC concentrations in either soils or vegetation within the Project footprint exceed predicted concentrations plus 30% variance (40% for high variability metals, i.e. aluminum, barium, lead, mercury, and molybdenum, see Section 5.0), the sampling frequency for soil and vegetation will be increased to a minimum of every three years.

In addition, if either soil or vegetation sampling under the EMP indicates this trigger for increased sampling frequency has been exceeded within the Project footprint, supplemental soil and vegetation sampling will be added to the program at locations outside of the Project footprint where baseline soil and vegetation sampling was conducted (shown in Figure 4.5-1 of Appendix 18-A of the EAC Application; AuRico 2016). A subset (~10) of sites outside of the Project footprint that were sampled in baseline soil and vegetation quality monitoring programs would require sampling. Sites will be preferentially selected for supplemental sampling if they are downwind of the Project footprint (where dustfall was predicted to be highest during Construction and Operations such as immediately south of the KUG TSF and around the main Mine Site area) or where soil and vegetation samples were co-collected previously.

The soil and vegetation sampling methodology and laboratory analysis described in Section 5.2.2.2 and 5.2.3.2 of the EMP (AuRico 2020b) will be followed in collecting supplemental soil and vegetation samples for the HHFP.

Priority species for supplemental sampling include country foods (i.e., crowberry and soapberry) and diet species for moose, hare, and grouse assessed in the HHRA in the EAC Application to ensure data comparability with baseline studies. Vegetation species identified as country foods or important forage species for wildlife were identified in Section 3.4. Vegetation sampling will be dependent on the types of species present at each supplemental sampling site. Where possible, multiple vegetation species will be co-collected at each sampling location; however, due to the large number of species sampled under baseline programs, not all baseline species need to be sampled in each year of supplemental sampling.

5. LEVELS OF ENVIRONMENTAL CHANGE

Predicted concentrations of COPCs in water, sediment, soil, and vegetation were used to define the acceptable level of change relative to baseline conditions. The predicted concentrations of COPCs were considered to be acceptable because, in the EAC Application, no residual effects to human health were expected based on this level of incremental change relative to baseline concentrations in environmental media (Chapter 18 and Appendix 18-B).

The BC MOE (2013) has defined no change in surface water quality as a difference of no greater than 20% since laboratory precision for measurement of low concentration metals in replicate samples is typically no better than 20% (quantified as the relative percent difference; RPD) and natural variability is often greater than 20%. Changes in concentration below this threshold are not likely to be measurable or statistically different from each other. Therefore, the trigger level to identify concentrations that are measurably different than those used in the EAC Application is predicted concentrations plus 20%.

The issues with laboratory precision and natural variability also apply to sampling other types of environmental media. Natural matrix variability/heterogeneity is generally higher in soils and

sediments than in water and higher acceptable RPDs on the order of 30 to 40% are reasonable for these media (Austin 2015). Therefore, a magnitude of 30% change relative to predicted concentrations will be applied to sediment, soil, and dustfall monitoring for most COPCs, and a magnitude of 40% will be applied to high variability metal COPCs (i.e., aluminum, barium, lead, mercury, and molybdenum) as identified in Austin (2015).

5.1 WATER

If the results of surface water quality monitoring at the seven surface water quality model nodes (i.e., KN-11b, WQ-01, WQ-14F, WQ-17, WQ-18, Thutade Lake, and Amazay Lake) indicate that COPC concentrations exceed predicted Project concentrations during the Construction or Operations phases (as described in Appendix 11-D of the EAC Application and Appendix 5-G of the Joint MA/EMA Permit Application) plus 20% for at least three consecutive samples (i.e., for a duration of at least three months except for Thutade Lake, which will be sampled quarterly), a HHRA for country foods will be triggered.

5.2 SEDIMENT

If the results of sediment quality monitoring indicate that COPC concentrations in sediment exceed established baseline concentrations (as described in Section 14.4.3.3 of the EAC Application, since sediment quality is not expected to change from baseline conditions due to the Project) by 30% (40% for high variability metals) for at least three consecutive samples (i.e., for at least three years), a HHRA for country foods will be triggered.

5.3 FISH

A country foods risk assessment for fish will only be triggered by increases in COPC concentrations of substances in water and sediments that are known to bioconcentrate or bioaccumulate in fish above levels of environmental change set out in Sections 5.1 and 5.2. Fish tissue COPC concentrations are generally of higher variability than COPC concentrations in other environmental media due to various factors, including smaller sample size, matrix differences, fish age, developmental stage, life history, habitat, and condition factor. Therefore, fish tissue monitoring data obtained as part of the Adult Fish Monitoring Study of the FAEMP and SeMP will not be used to set trigger levels, but rather to update the country foods risk assessment, if required.

5.4 SOIL AND VEGETATION

If the results of soil quality monitoring indicate that COPC concentrations in soil samples exceed predicted concentrations during the Construction or Operations phases (as shown in Table 3.4-2 of Appendix 18-B of the EAC Application) plus 30% (40% for high variability metals) for at least three consecutive samples (i.e., for at least nine years), a HHRA for country foods will be triggered.

If the results of vegetation tissue metals monitoring indicate that COPC concentrations in vegetation samples exceed predicted concentrations during the Construction or Operations phases (as shown in Tables 4.6-1 and 4.6-2 of Appendix 18-B of the EAC Application) plus 30% (40% for high variability metals) for at least three consecutive samples (i.e., for at least nine years), a HHRA for country foods will be triggered.

6. COUNTRY FOODS RISK ASSESSMENT STEPS

Should monitoring results demonstrate that concentration levels for contaminants of potential concern are greater than the identified levels of environmental change (Section 5), the HHRA for the consumption of country foods exposed to these contaminants will be updated. As with the HHRAs conducted in the EAC Application (Appendices 18-A and 18-B), the HHRA for country foods will be divided into the following six steps based on guidance from Health Canada (2007, 2010a, 2010e, 2010d), and considering any updates to guidance as issued from time to time:

1. Problem Formulation: the conceptual model developed for Project conditions for the EAC Application for conducting the HHRA will be updated in the problem formulation stage. The problem formulation will revisit human receptors and human receptor characteristics, identify the COPCs and media that have triggered the HHRA, and describe food chain and exposure routes considered in the assessment (country foods ingestion only).
2. Exposure Assessment: exposure equations, COPC-specific characteristics, receptor assumptions, and the measured (water, soil, sediment, vegetation) or calculated (country food species) COPC concentrations are presented in this section. An exposure dose is calculated to estimate the daily intake of COPCs for human receptors from the consumption of country foods. For country foods where tissue concentrations were not measured during monitoring studies (i.e., moose, snowshoe hare, and ruffed grouse), food chain modelling will be conducted to estimate tissue concentrations. Food chain modelling of COPC uptake into wildlife tissue is generally highly conservative relative to direct measurement and has the potential to overestimate COPC tissue concentrations by orders of magnitude (Health Canada 2010d). This maintains the conservative nature of the HHRA and ensures with a high degree of certainty that risks will not be under-estimated or overlooked (Health Canada 2010d).
3. Toxicity Assessment: the toxicity reference values for the COPCs (TRVs; levels of daily exposure that can be taken into the body without appreciable health risk) are identified.
4. Risk Characterization: HQs are calculated for threshold chemicals (i.e., non-carcinogens) and ILCRs for non-threshold chemicals (i.e., carcinogens). The exposure and effects assessments are integrated by comparing the estimated exposure dose of COPCs from country foods with TRVs to produce quantitative risk estimates (HQs or ILCRs). Exposure via the country foods pathway is compared to a single TRV for each COPC.
5. Uncertainty Analysis and Data Gaps: the assumptions made throughout the HHRA and their effects on the confidence in the conclusions are evaluated.
6. Conclusions: the potential for risk to human health from country foods consumption is described based on the results of the risk characterization, with qualitative consideration of uncertainties and data gaps that might influence the quantitative assessment.

If additional risk assessment guidance from Health Canada becomes available, it will also be considered for use in the HHRA.

7. METHODOLOGY FOR CALCULATING HAZARD QUOTIENTS AND INCREMENTAL LIFETIME CANCER RISK

Using the results of the exposure assessment and TRV assessment (described in Section 6 above), human health risks are quantified using HQs for non-carcinogens and ILCRs for carcinogens. The HQ is the ratio between the estimated exposure dose and the TRV and provides a measure of the potential risk to a receptor for COPCs ingested from country foods. The ILCR is calculated for COPC(s) that may be associated with carcinogenic potential through ingestion of country foods (i.e., arsenic).

7.1 HAZARD QUOTIENTS

The following equation (Health Canada 2010a) is used to estimate the daily exposure dose for each COPC from the total consumption of country foods:

$$Dose_{CF} = \sum \frac{C_{CF_i} \times IR_{CF_i} \times RAF \times DE}{BW} \quad \text{[Equation 1]}$$

where:

- $Dose_{CF}$ = total estimated daily exposure dose of the COPC from country foods ingestion (mg COPC/kg BW/day)
- IR_{CFi} = ingestion rate for country food *i* (kg/day)
- C_{CFi} = concentration of COPC in country food *i* (mg/kg)
- RAF = relative absorption factor from the gastrointestinal tract for the COPC (unitless)
- DE = number of days exposed by consuming country food *i* from the area, per 365 days (days/365 days)
- BW = body weight (kg BW)

The $Dose_{CF}$ of each COPC from country foods ingestion (in mg/kg BW/day) is divided by the COPC-specific TRV (in mg/kg BW/day) to obtain the HQ (unitless) for each COPC, as follows (Health Canada 2010a):

$$HQ = \frac{Dose_{CF}}{TRV} \quad \text{[Equation 2]}$$

where:

- HQ = hazard quotient for the COPC from country foods ingestion (unitless)
- $Dose_{CF}$ = total estimated daily exposure dose of the COPC from country foods ingestion (mg COPC/kg BW/day)
- TRV = toxicity reference value for the COPC (mg COPC/kg BW/day)

For non-carcinogenic COPCs, Health Canada (2010a) suggests that an HQ of less than 0.2 indicates that the exposure does not pose a significant health risk to human receptors. An HQ of 0.2 is used as the benchmark (instead of 1.0) because the assessment does not consider intake of contaminants from all potential exposure routes (e.g., from drinking water ingestion, air inhalation, dermal contact, incidental soil ingestion).

An HQ value greater than 0.2 does not necessarily indicate that adverse health effects will occur since the TRVs are conservative (i.e., protect human health by including additional uncertainty factors) and the assumptions made in the assessment are conservative (e.g., 100% of exposure to country foods comes from within the Human Health LSA).

The results for HQ values and uncertainties for country foods consumption during the assessed monitoring period (i.e., Construction, Operations) will be compared qualitatively to established baseline and predicted Project HQ values.

7.2 INCREMENTAL LIFETIME CANCER RISK

Arsenic is the only potential Project-related COPC that is considered carcinogenic through the ingestion pathway. The following equation is used to calculate the lifetime average daily dose (LADD) from ingestion of arsenic in country foods (Health Canada 2010a):

$$LADD_{CF} = \sum \frac{C_{CF_i} \times IRCF_i \times RAF \times DE \times YE}{BW \times DE \times LE} \quad \text{[Equation 3]}$$

where:

- $LADD_{CF}$ = lifetime average daily dose of arsenic from country foods ingestion (mg/kg BW/day)
- C_{CFi} = concentration of arsenic in country food *i* (mg/kg)
- IR_{CFi} = ingestion rate of country food *i* (kg/day)
- *RAF* = relative absorption factor for arsenic (unitless)
- *DE* = number of days exposed by consuming country food *i* from the area, per 365 days (days/365 days)
- *YE* = number of years exposed by consuming country food *i* from the area (years)
- *BW* = body weight (kg)
- *LE* = life expectancy (years)

Carcinogenic risks due to arsenic exposure are calculated as ILCR estimates according to the following formula (Health Canada 2010a):

$$ILCR = LADD_{CF} \times \text{Oral CSF} \quad \text{[Equation 4]}$$

where:

- *ILCR* = incremental lifetime cancer risk due to arsenic (unitless)
- $LADD_{CF}$ = lifetime average daily dose of arsenic from country foods ingestion (mg/kg BW/day)
- *Oral CSF* = oral cancer slope factor for arsenic $(mg/kg\ BW/day)^{-1}$

The oral cancer slope factor (CSF) for arsenic is 1.80 $(mg/kg\ BW/day)^{-1}$ (Health Canada 2010b). If the calculated ILCR for arsenic ingestion is less than 1×10^{-5}, it is considered to be of negligible risk (Health Canada 2010a).

The results of the ILCR assessment and uncertainties for country foods consumption during the assessed monitoring period (i.e., Construction, Operation) will be compared qualitatively to established baseline and predicted Project ILCR values.

8. DATA MANAGEMENT AND REPORTING FRAMEWORK

Standard operating procedures (SOPs) will be used for environmental data collection, as referenced in the MSWMP, FAEMP, SeMP, and EMP. SOPs will cover all aspects of data collection, data processing, data quality assurance and control (QA/QC), and data management. SOPs will include duplicate sampling, relevant blanks, chain-of-custody procedures, and recordkeeping. The SOPs will be reassessed and updated when necessary, as part of the iterative QA/QC process conducted under the MSWMP (AuRico 2017c), the FAEMP (AuRico 2017a), the SeMP (AuRico 2017d), and the EMP(AuRico 2020b).

AuRico Metals Inc. will assume the responsibility of data management and record-keeping of monitoring results. Data are entered into suitable electronic databases, checked for QA/QC purposes, and stored. Data are entered in a format and program that allow for comparison over time and storage in a single file format for each type of survey or monitoring activity. Monitoring data will be stored for the life of the mine and be made available for review upon request. Designated personnel will coordinate preparation, review, and distribution of the data and reports required for regulatory purposes.

The environmental media data, including COPC concentrations, gathered during monitoring will be presented annually in monitoring reports for surface water, sediments, fish, soil, and vegetation under the MSWMP (described in Section 7.1 of the MSWMP; AuRico 2017c), FAEMP (described in Section 8.3.6 of the FAEMP; AuRico 2017a), SeMP (described in Section 7.1.1 of the SeMP; AuRico 2017d), and EMP (described in Section 6.2 of the EMP; AuRico 2020b).

Annual HHFP reports will be prepared or reviewed by a person with expertise in HHRA. The annual HHFP report will provide the following:

- summary of environmental media COPC monitoring results for surface water, sediments, fish tissues, soils, and vegetation, including any supplemental sampling results (Section 4), and results of CAC monitoring if results indicate exceedance of objectives or standards (Section 1.2; AuRico 2020a, AuRico 2020c);
- comparison of monitoring results to established baseline and predicted COPC concentration data reported in the EAC Application;
- calculated levels of environmental change in environmental media (Section 5) and interpretation;
- identification of any emerging negative environmental trends likely attributable to the Project identified by monitoring and if supplemental monitoring (i.e., increased sampling frequency or collection of additional soils or vegetation samples outside of the Project footprint) has been triggered; and
- description of proposed mitigation measures, revisions to the management plans to address emerging negative trends, or to update the HHRA for country foods, if required.

If the levels of environmental change exceed the levels described in Section 5, then a HHRA for country foods will be triggered following the steps and methodology described in Sections 6 and 7. The results of the updated HHRA for country foods will be communicated to Indigenous groups.

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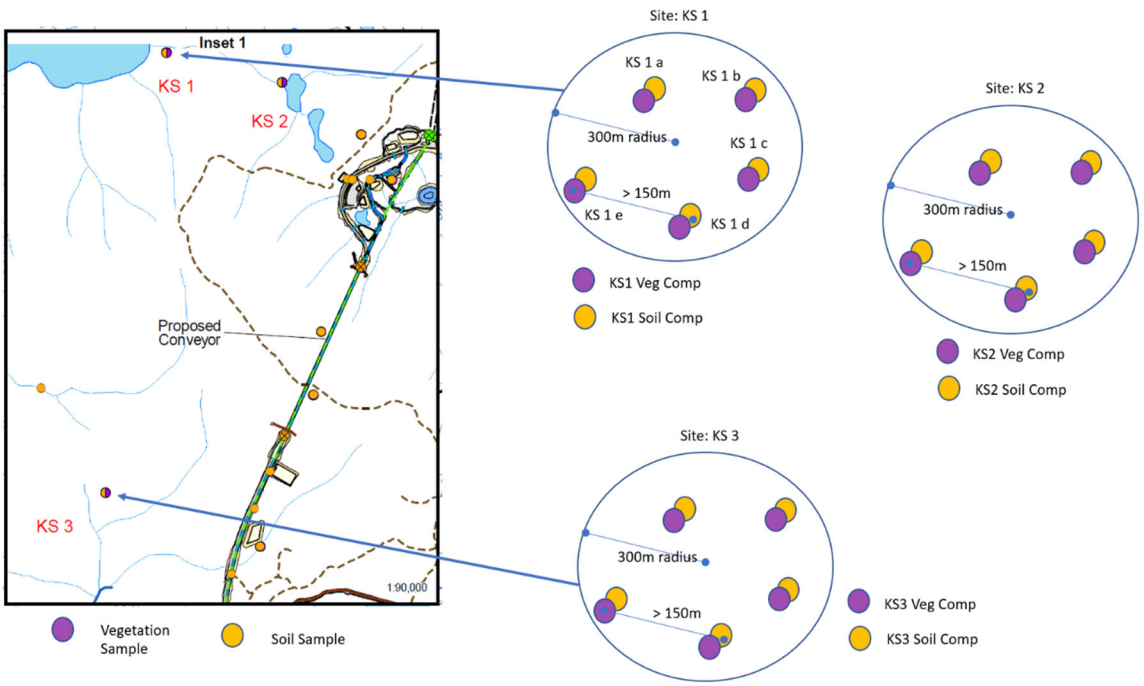
APPENDIX C

Conceptual Replicate Study Design


Inset 1
KS 1
KS 2
KS 3
Proposed Conveyor
1:90,000
Vegetation Sample
Soil Sample
Site: KS 1
KS 1 a
KS 1 b
300m radius
KS 1 c
> 150m
KS 1 e
KS 1 d
KS1 Veg Comp
KS1 Soil Comp
Site: KS 2
300m radius
> 150m
KS2 Veg Comp
KS2 Soil Comp
Site: KS 3
300m radius
> 150m
KS3 Veg Comp
KS3 Soil Comp

Site Identifier	Study Area	Station	Station Coordinates (NAD83)	
			North Latitude	West Longitude
Kemess Underground (KUG)	KUG1	KUG1A	57°03'35.71"	-126°45'05.03"
		KUG1B	57°03'30.27"	-126°45'00.59"
		KUG1C	57°03'33.11"	-126°44'41.69"
		KUG1D	57°03'40.14"	-126°44'42.94"
		KUG1E	57°03'42.97"	-126°44'57.61"
	KUG2	KUG2A	57°03'29.35"	-126°45'36.96"
		KUG2B	57°03'35.02"	-126°45'50.39"
		KUG2C	57°03'43.40"	-126°45'52.13"
		KUG2D	57°03'48.81"	-126°45'37.46"
		KUG2E	57°03'39.62"	-126°45'23.53"
	KUG3	KUG3A	57°03’18.58”	-126°45’14.27”
		KUG3B	57°03’18.25"	-126°45’15.54”
		KUG3C	57°03’16.47”	-126°45’11.51”
Kemess South (KS)	KS1	KS1A	57°02’09.03”	-126°46’56.55”
		KS1B	57°02’08.96”	-126°46’54.77”
		KS1C	57°02’09.71”	-126°46’54.04”
	KS2	KS2A	57°02’02.40”	-126°46’21.21”
		KS2B	57°02’03.87”	-126°46’15.96”
		KS2C	57°01’57.29”	-126°46’19.35”
	KS3	KS3A	57°01’17.70”	-126°47’29.58”
		KS3B	57°01’16.58”	-126°47’26.84”
		KS3C	57°01’15.74”	-126°47’25.16"
	KS4	KS4A	57°00’21.20”	-126°44’22.77”
		KS4B	57°00’21.83”	-126°44’21.06”
		KS4C	57°00’22.28”	-126°44’20.15”
Omineca Resource Access Road (RD)	RD1	RD1A	56°58’49.27”	-126°46’35.28”
		RD1B	56°58’53.13”	-126°46’34.10”
		RD1C	56°58’54.34”	-126°46’33.64”
	RD2	RD2A	56°57’06.36”	-126°43’18.18”
		RD2B	56°57’07.29”	-126°43’21.48”
		RD2C	56°57’07.20”	-126°43’23.65”
	RD3	RD3A	56°23’09.31”	-126°28’56.58”
		RD3B	56°23’10.24”	-126°28’52.14”
		RD3C	56°23’08.96”	-126°28’52.44”
Reference Site 1	REF1	REF1A	57°06'01.72"	-126°45'05.41"
		REF1B	57°06'03.25"	-126°45'13.97"
		REF1C	57°05'58.97"	-126°45'19.52"
		REF1D	57°05'51.42"	-126°45'16.45"
		REF1E	57°05'55.32"	-126°45'00.78"
Reference Site 2	REF2	REF2A	57°00'07.86"	-126°38'13.29"
		REF2B	57°00'03.31"	-126°38'09.15"
		REF2C	57°00'00.33"	-126°37'46.02"
		REF2D	57°00'10.07"	-126°37'41.30"
		REF2E	57°00'19.53"	-126°37'48.26"
Reference Site 3	REF3	REF3A	57°00'30.67"	-126°40'05.67"
		REF3B	57°00'34.59"	-126°40'14.62"
		REF3C	57°00'42.30"	-126°39'52.26"
		REF3D	57°00'37.84"	-126°39'48.27"
		REF3E	57°00'31.07"	-126°39.49.01"

APPENDIX D

Soil Screening Tables and Laboratory Data

Appendix Table D.13: Metal Concentrations and pH of Soil Sampled at Omineca Resource Access Road Study Area 3 (RD3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				RD3A	RD3B	RD3C	RD3 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
pH	pH unit	0.1	na	5.45	5.20	5.57	5.42
Aluminum	mg/kg dw	40	na	28,200	23,100	22,000	21,800
Antimony [e]	mg/kg dw	0.1	15	0.65	0.46	0.74	0.72
Arsenic [d]	mg/kg dw	0.3	10	16.60	15.30	19.60	18.00
Barium [c]	mg/kg dw	1	350	145	167	164	151
Beryllium [d]	mg/kg dw	0.1	1	0.39	0.33	0.37	0.34
Bismuth	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Boron [b]	mg/kg dw	2	2	<6	2.6	2.8	<6
Cadmium [d]	mg/kg dw	0.04	1	0.937	0.921	0.862	0.805
Calcium	mg/kg dw	100	na	7,220	8,810	8,900	7,540
Chromium [d]	mg/kg dw	1	60	65.6	61.9	62.4	59.9
Cobalt [c,d]	mg/kg dw	0.1	25	17.9	18.2	18.1	17.0
Copper [b]	mg/kg dw	0.4	63	48.3	42.8	52.3	49.2
Iron	mg/kg dw	20	na	42,700	35,800	37,300	37,100
Lead [b]	mg/kg dw	0.2	70	6.2	4.9	4.8	4.9
Lithium	mg/kg dw	0.1	na	16.4	12.4	13.7	13.4
Magnesium	mg/kg dw	10	na	11,100	10,000	10,300	9,720
Manganese [c]	mg/kg dw	0.4	2,000	1,160	1,370	1,730	1,310
Mercury [b]	mg/kg dw	0.04	6.6	0.049	0.043	0.045	0.045
Molybdenum [b]	mg/kg dw	0.1	5	2.13	1.98	1.92	1.83
Nickel [b]	mg/kg dw	0.6	45	45.8	43.6	61.5	53.1
Phosphorus	mg/kg dw	10	na	1,040	916	741	839
Potassium	mg/kg dw	40	na	743	818	691	578
Selenium [b,d]	mg/kg dw	0.2	1	1.02	1.31	0.89	1.07
Silver [e]	mg/kg dw	0.1	15	0.17	0.18	0.19	0.19
Sodium	mg/kg dw	50	na	245	279	323	213
Strontium	mg/kg dw	0.2	na	43.1	46.5	47.2	39.7
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	0.11	0.12	0.10	<0.1

Appendix Table D.13: Metal Concentrations and pH of Soil Sampled at Omineca Resource Access Road Study Area 3 (RD3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				RD3A	RD3B	RD3C	RD3 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Thorium	mg/kg dw	0.5	na	0.62	0.95	1.69	1.09
Tin [b]	mg/kg dw	0.2	5	0.36	0.33	0.32	0.33
Titanium	mg/kg dw	1	na	751	824	1,140	856
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	0.30	<0.2
Uranium [b]	mg/kg dw	0.05	23	2.17	1.31	1.56	1.60
Vanadium [c]	mg/kg dw	1	100	109.0	99.3	99.5	95.3
Zinc [d]	mg/kg dw	2	150	198	147	128	140
Zirconium	mg/kg dw	2	na	<2	<2	2.3	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.12: Metal Concentrations and pH of Soil Sampled at Omineca Resource Access Road Study Area 2 (RD2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				RD2A	RD2B	RD2C	RD2 COMP
				24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
pH	pH unit	0.1	na	5.67	5.72	5.34	5.51
Aluminum	mg/kg dw	40	na	17,200	19,700	19,600	18,900
Antimony [e]	mg/kg dw	0.1	15	0.34	0.31	0.34	0.34
Arsenic [d]	mg/kg dw	0.3	10	4.37	4.82	4.77	4.77
Barium [c]	mg/kg dw	1	350	122	154	149	136
Beryllium [d]	mg/kg dw	0.1	1	0.37	0.42	0.42	0.41
Bismuth	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Boron [b]	mg/kg dw	2	2	<4	<4	<4	<4
Cadmium [d]	mg/kg dw	0.04	1	0.159	0.212	0.162	0.159
Calcium	mg/kg dw	100	na	7,190	8,210	8,110	7,760
Chromium [d]	mg/kg dw	1	60	36.8	37.8	43.0	43.2
Cobalt [c,d]	mg/kg dw	0.1	25	12.0	13.6	13.7	13.1
Copper [b]	mg/kg dw	0.4	63	38.2	47.3	46.7	43.3
Iron	mg/kg dw	20	na	30,400	30,000	32,100	32,400
Lead [b]	mg/kg dw	0.2	70	4.6	5.1	5.3	5.1
Lithium	mg/kg dw	0.1	na	10.0	10.5	10.4	10.6
Magnesium	mg/kg dw	10	na	7,120	7,600	7,740	7,500
Manganese [c]	mg/kg dw	0.4	2,000	523	651	622	600
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	0.50	0.63	0.63	0.57
Nickel [b]	mg/kg dw	0.6	45	21.8	24.0	24.4	23.8
Phosphorus	mg/kg dw	10	na	455	516	497	510
Potassium	mg/kg dw	40	na	560	577	562	604
Selenium [b,d]	mg/kg dw	0.2	1	<0.2	<0.2	<0.2	<0.2
Silver [e]	mg/kg dw	0.1	15	<0.1	<0.1	<0.1	<0.1
Sodium	mg/kg dw	50	na	85	98	99	95
Strontium	mg/kg dw	0.2	na	53.6	61.1	59.9	58.1
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.12: Metal Concentrations and pH of Soil Sampled at Omineca Resource Access Road Study Area 2 (RD2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				RD2A	RD2B	RD2C	RD2 COMP
				24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
Thorium	mg/kg dw	0.5	na	1.15	1.33	1.58	1.33
Tin [b]	mg/kg dw	0.2	5	0.36	0.34	0.39	0.40
Titanium	mg/kg dw	1	na	865	772	821	898
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.45	0.60	0.62	0.54
Vanadium [c]	mg/kg dw	1	100	82.3	78.9	85.7	87.3
Zinc [d]	mg/kg dw	2	150	48.0	55.1	51.6	51.4
Zirconium	mg/kg dw	2	na	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.11: Metal Concentrations and pH of Soil Sampled at Omineca Resource Access Road Study Area 1 (RD1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				RD1A	RD1B	RD1C	RD1 COMP
				24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
pH	pH unit	0.1	na	6.02	5.21	4.95	5.02
Aluminum	mg/kg dw	40	na	15,700	14,000	16,700	15,800
Antimony [e]	mg/kg dw	0.1	15	0.48	0.53	0.55	0.56
Arsenic [d]	mg/kg dw	0.3	10	6.02	5.28	6.30	5.98
Barium [c]	mg/kg dw	1	350	71	107	121	100
Beryllium [d]	mg/kg dw	0.1	1	0.31	0.28	0.28	0.29
Bismuth	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Boron [b]	mg/kg dw	2	2	<4	<4	<6	<4
Cadmium [d]	mg/kg dw	0.04	1	0.121	0.321	0.430	0.303
Calcium	mg/kg dw	100	na	6,230	5,900	6,650	6,390
Chromium [d]	mg/kg dw	1	60	30.0	33.3	34.1	33.4
Cobalt [c,d]	mg/kg dw	0.1	25	11.6	10.6	12.0	11.7
Copper [b]	mg/kg dw	0.4	63	30.5	22.5	22.3	23.5
Iron	mg/kg dw	20	na	32,300	31,600	33,700	31,600
Lead [b]	mg/kg dw	0.2	70	4.1	4.8	5.7	5.0
Lithium	mg/kg dw	0.1	na	10.5	8.7	9.7	9.9
Magnesium	mg/kg dw	10	na	8,810	7,100	7,630	8,200
Manganese [c]	mg/kg dw	0.4	2,000	564	603	572	607
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	0.54	0.78	0.94	0.78
Nickel [b]	mg/kg dw	0.6	45	21.1	17.2	19.5	19.1
Phosphorus	mg/kg dw	10	na	661	553	572	571
Potassium	mg/kg dw	40	na	502	474	749	579
Selenium [b,d]	mg/kg dw	0.2	1	<0.2	<0.2	<0.2	<0.2
Silver [e]	mg/kg dw	0.1	15	<0.1	<0.1	<0.1	<0.1
Sodium	mg/kg dw	50	na	99	82	87	92
Strontium	mg/kg dw	0.2	na	56.0	47.0	63.8	51.0
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.11: Metal Concentrations and pH of Soil Sampled at Omineca Resource Access Road Study Area 1 (RD1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				RD1A	RD1B	RD1C	RD1 COMP
				24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
Thorium	mg/kg dw	0.5	na	1.14	1.01	1.21	0.99
Tin [b]	mg/kg dw	0.2	5	0.29	0.32	0.40	0.32
Titanium	mg/kg dw	1	na	931	874	893	969
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.44	0.44	0.47	0.45
Vanadium [c]	mg/kg dw	1	100	85.9	84.2	93.9	86.4
Zinc [d]	mg/kg dw	2	150	53.3	51.5	54.2	53.8
Zirconium	mg/kg dw	2	na	3.9	2.1	<2	2.3

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.10: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 4 (KS4) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS4A	KS4B	KS4C	KS4 COMP
				24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
pH	pH unit	0.1	na	6.05	4.99	5.18	5.29
Aluminum	mg/kg dw	40	na	18,600	19,800	18,400	18,600
Antimony [e]	mg/kg dw	0.1	15	0.62	0.90	0.71	0.70
Arsenic [d]	mg/kg dw	0.3	10	11.20	9.85	8.29	9.75
Barium [c]	mg/kg dw	1	350	96	112	122	160
Beryllium [d]	mg/kg dw	0.1	1	0.38	0.44	0.41	0.40
Bismuth	mg/kg dw	0.1	na	<0.1	0.10	<0.1	<0.1
Boron [b]	mg/kg dw	2	2	<4	<4	<4	<4
Cadmium [d]	mg/kg dw	0.04	1	0.231	0.730	0.264	0.303
Calcium	mg/kg dw	100	na	7,990	7,770	7,960	7,330
Chromium [d]	mg/kg dw	1	60	36.7	45.5	46.3	41.2
Cobalt [c,d]	mg/kg dw	0.1	25	12.3	13.3	12.1	12.4
Copper [b]	mg/kg dw	0.4	63	39.0	34.9	36.3	36.4
Iron	mg/kg dw	20	na	31,900	38,500	37,600	35,000
Lead [b]	mg/kg dw	0.2	70	6.0	7.0	6.6	6.8
Lithium	mg/kg dw	0.1	na	12.0	12.3	11.1	11.5
Magnesium	mg/kg dw	10	na	8,380	8,290	7,800	8,410
Manganese [c]	mg/kg dw	0.4	2,000	679	629	573	621
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	0.85	1.27	1.12	1.05
Nickel [b]	mg/kg dw	0.6	45	22.6	22.7	21.5	21.8
Phosphorus	mg/kg dw	10	na	552	583	555	583
Potassium	mg/kg dw	40	na	583	706	540	547
Selenium [b,d]	mg/kg dw	0.2	1	0.23	<0.2	<0.2	<0.2
Silver [e]	mg/kg dw	0.1	15	<0.1	<0.1	<0.1	<0.1
Sodium	mg/kg dw	50	na	113	115	125	124
Strontium	mg/kg dw	0.2	na	64.2	64.1	68.3	69.6
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.10: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 4 (KS4) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS4A	KS4B	KS4C	KS4 COMP
				24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
Thorium	mg/kg dw	0.5	na	1.29	1.45	1.69	1.30
Tin [b]	mg/kg dw	0.2	5	0.39	0.44	0.41	0.38
Titanium	mg/kg dw	1	na	975	1,140	1,090	1,010
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	0.32	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.71	0.78	0.66	0.65
Vanadium [c]	mg/kg dw	1	100	85.2	109.0	108.0	97.2
Zinc [d]	mg/kg dw	2	150	57.6	66.5	58.2	60.5
Zirconium	mg/kg dw	2	na	<2	2.1	3.9	2.6

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.9: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 3 (KS3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS3A	KS3B	KS3C	KS3 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
pH	pH unit	0.1	na	5.00	5.47	5.00	5.24
Aluminum	mg/kg dw	40	na	25,300	34,000	26,800	29,600
Antimony [e]	mg/kg dw	0.1	15	0.40	0.36	0.33	0.44
Arsenic [d]	mg/kg dw	0.3	10	5.55	7.75	6.74	7.04
Barium [c]	mg/kg dw	1	350	102	144	135	131
Beryllium [d]	mg/kg dw	0.1	1	0.59	2.38	0.94	1.54
Bismuth	mg/kg dw	0.1	na	0.45	0.46	0.43	0.43
Boron [b]	mg/kg dw	2	2	<4	<4	<4	<6
Cadmium [d]	mg/kg dw	0.04	1	0.817	0.679	0.632	0.716
Calcium	mg/kg dw	100	na	1,570	1,710	1,700	1,680
Chromium [d]	mg/kg dw	1	60	23.1	28.4	26.9	26.1
Cobalt [c,d]	mg/kg dw	0.1	25	8.2	48.7	21.8	32.2
Copper [b]	mg/kg dw	0.4	63	88.2	454.0	173.0	301.0
Iron	mg/kg dw	20	na	41,600	40,500	37,200	39,700
Lead [b]	mg/kg dw	0.2	70	12.0	8.1	7.1	8.4
Lithium	mg/kg dw	0.1	na	12.6	41.6	25.8	29.6
Magnesium	mg/kg dw	10	na	8,290	10,000	8,910	8,990
Manganese [c]	mg/kg dw	0.4	2,000	506	728	675	668
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	6.85	9.78	9.15	8.85
Nickel [b]	mg/kg dw	0.6	45	12.3	58.0	28.5	39.8
Phosphorus	mg/kg dw	10	na	912	808	902	843
Potassium	mg/kg dw	40	na	864	631	666	688
Selenium [b,d]	mg/kg dw	0.2	1	0.37	1.21	0.69	0.88
Silver [e]	mg/kg dw	0.1	15	0.15	0.16	0.19	0.18
Sodium	mg/kg dw	50	na	75	86	74	76
Strontium	mg/kg dw	0.2	na	21.7	25.3	27.4	25.9
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	0.36	0.36	0.27	0.32
Thallium [b]	mg/kg dw	0.1	1	<0.1	0.13	<0.1	0.10

Appendix Table D.9: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 3 (KS3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS3A	KS3B	KS3C	KS3 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Thorium	mg/kg dw	0.5	na	<0.5	0.63	<0.5	<0.5
Tin [b]	mg/kg dw	0.2	5	1.42	0.73	0.78	0.84
Titanium	mg/kg dw	1	na	342	242	219	282
Tungsten	mg/kg dw	0.2	na	0.23	<0.2	<0.2	0.22
Uranium [b]	mg/kg dw	0.05	23	0.53	1.30	0.78	0.94
Vanadium [c]	mg/kg dw	1	100	90.3	95.8	96.0	91.7
Zinc [d]	mg/kg dw	2	150	67.4	175.0	111.0	135.0
Zirconium	mg/kg dw	2	na	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.8: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 2 (KS2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS2A	KS2B	KS2C	KS2 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
pH	pH unit	0.1	na	5.31	6.20	5.82	5.63
Aluminum	mg/kg dw	40	na	16,700	15,000	19,900	19,100
Antimony [e]	mg/kg dw	0.1	15	0.30	0.59	0.40	0.35
Arsenic [d]	mg/kg dw	0.3	10	3.39	10.90	9.01	9.61
Barium [c]	mg/kg dw	1	350	97	146	136	130
Beryllium [d]	mg/kg dw	0.1	1	0.37	0.30	0.38	0.35
Bismuth	mg/kg dw	0.1	na	0.10	<0.1	0.17	0.14
Boron [b]	mg/kg dw	2	2	<2	<6	<4	<2
Cadmium [d]	mg/kg dw	0.04	1	<0.12	0.359	0.234	<0.2
Calcium	mg/kg dw	100	na	3,270	8,720	5,600	5,370
Chromium [d]	mg/kg dw	1	60	30.5	25.1	29.9	34.0
Cobalt [c,d]	mg/kg dw	0.1	25	8.3	8.9	8.9	10.0
Copper [b]	mg/kg dw	0.4	63	30.2	50.1	61.5	51.8
Iron	mg/kg dw	20	na	24,100	25,200	26,000	29,000
Lead [b]	mg/kg dw	0.2	70	6.2	5.6	8.8	8.4
Lithium	mg/kg dw	0.1	na	13.6	10.1	11.9	11.4
Magnesium	mg/kg dw	10	na	6,890	6,020	6,210	7,330
Manganese [c]	mg/kg dw	0.4	2,000	261	442	437	395
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	3.84	13.20	23.70	15.50
Nickel [b]	mg/kg dw	0.6	45	21.0	18.0	19.3	22.2
Phosphorus	mg/kg dw	10	na	266	479	551	436
Potassium	mg/kg dw	40	na	610	547	529	591
Selenium [b,d]	mg/kg dw	0.2	1	<0.2	0.46	0.86	0.59
Silver [e]	mg/kg dw	0.1	15	<0.1	0.10	0.19	0.12
Sodium	mg/kg dw	50	na	148	114	139	124
Strontium	mg/kg dw	0.2	na	27.4	56.7	41.6	39.6
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.8: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 2 (KS2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS2A	KS2B	KS2C	KS2 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Thorium	mg/kg dw	0.5	na	1.41	0.68	0.77	1.50
Tin [b]	mg/kg dw	0.2	5	0.39	0.31	0.41	0.41
Titanium	mg/kg dw	1	na	864	693	559	643
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.36	0.62	0.42	0.48
Vanadium [c]	mg/kg dw	1	100	68.0	60.9	63.8	73.5
Zinc [d]	mg/kg dw	2	150	47.0	55.6	68.0	65.2
Zirconium	mg/kg dw	2	na	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.7: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 1 (KS1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS1A	KS1B	KS1C	KS1 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
pH	pH unit	0.1	na	5.27	5.06	5.60	5.26
Aluminum	mg/kg dw	40	na	29,100	26,600	17,800	30,400
Antimony [e]	mg/kg dw	0.1	15	0.66	0.46	0.45	0.70
Arsenic [d]	mg/kg dw	0.3	10	9.40	7.96	5.11	8.81
Barium [c]	mg/kg dw	1	350	117	141	77	137
Beryllium [d]	mg/kg dw	0.1	1	0.58	0.55	0.33	0.57
Bismuth	mg/kg dw	0.1	na	2.38	1.51	0.40	2.06
Boron [b]	mg/kg dw	2	2	<2	<2	<2	<2
Cadmium [d]	mg/kg dw	0.04	1	2.130	1.220	0.707	1.600
Calcium	mg/kg dw	100	na	10,900	9,420	5,680	10,900
Chromium [d]	mg/kg dw	1	60	31.7	30.7	31.4	36.9
Cobalt [c,d]	mg/kg dw	0.1	25	25.3	19.4	12.3	22.5
Copper [b]	mg/kg dw	0.4	63	187.0	116.0	70.5	160.0
Iron	mg/kg dw	20	na	53,200	42,100	31,500	51,700
Lead [b]	mg/kg dw	0.2	70	29.3	20.7	10.0	25.3
Lithium	mg/kg dw	0.1	na	18.1	17.0	13.3	18.6
Magnesium	mg/kg dw	10	na	12,500	9,420	10,500	13,000
Manganese [c]	mg/kg dw	0.4	2,000	1,030	933	735	1,060
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	17.90	19.00	8.92	18.30
Nickel [b]	mg/kg dw	0.6	45	17.4	18.0	17.1	22.3
Phosphorus	mg/kg dw	10	na	691	734	536	800
Potassium	mg/kg dw	40	na	852	799	631	892
Selenium [b,d]	mg/kg dw	0.2	1	0.93	1.08	0.42	0.83
Silver [e]	mg/kg dw	0.1	15	0.68	0.34	0.20	0.55
Sodium	mg/kg dw	50	na	181	123	120	176
Strontium	mg/kg dw	0.2	na	102.0	79.7	46.4	96.9
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	1.45	0.85	0.33	1.25
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.7: Metal Concentrations and pH of Soil Sampled at Kemess South Study Area 1 (KS1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KS1A	KS1B	KS1C	KS1 COMP
				25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Thorium	mg/kg dw	0.5	na	1.67	1.28	1.33	1.65
Tin [b]	mg/kg dw	0.2	5	0.51	0.47	0.41	0.63
Titanium	mg/kg dw	1	na	750	400	683	776
Tungsten	mg/kg dw	0.2	na	0.45	0.26	<0.2	0.39
Uranium [b]	mg/kg dw	0.05	23	2.58	2.83	0.93	2.56
Vanadium [c]	mg/kg dw	1	100	100.0	84.4	73.0	106.0
Zinc [d]	mg/kg dw	2	150	244.0	186.0	119.0	222.0
Zirconium	mg/kg dw	2	na	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.6: Metal Concentrations and pH of Soil Sampled at Kemess Underground Study Area 3 (KUG3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KUG3A	KUG3B	KUG3C	KUG3-COMP
				23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22
pH	pH unit	0.1	na	5.63	5.49	5.13	5.61
Aluminum	mg/kg dw	40	na	33,500	37,600	34,200	36,100
Antimony [e]	mg/kg dw	0.1	15	1.40	1.64	1.29	1.71
Arsenic [d]	mg/kg dw	0.3	10	19.00	19.80	16.60	21.00
Barium [c]	mg/kg dw	1	350	100	130	134	114
Beryllium [d]	mg/kg dw	0.1	1	0.63	0.57	0.52	0.63
Bismuth	mg/kg dw	0.1	na	1.03	2.20	2.65	1.34
Boron [b]	mg/kg dw	2	2	<2	<2	<2	<2
Cadmium [d]	mg/kg dw	0.04	1	0.590	0.898	0.941	0.742
Calcium	mg/kg dw	100	na	2,320	2,570	2,680	2,920
Chromium [d]	mg/kg dw	1	60	30.9	55.7	44.7	37.4
Cobalt [c,d]	mg/kg dw	0.1	25	33.6	47.9	32.5	39.0
Copper [b]	mg/kg dw	0.4	63	121.0	195.0	150.0	137.0
Iron	mg/kg dw	20	na	48,100	65,900	58,300	53,100
Lead [b]	mg/kg dw	0.2	70	28.1	38.1	37.9	38.5
Lithium	mg/kg dw	0.1	na	14.6	14.5	12.1	14.0
Magnesium	mg/kg dw	10	na	10,400	16,000	13,300	11,400
Manganese [c]	mg/kg dw	0.4	2,000	1,280	1,680	1,970	1,450
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	0.061	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	1.51	3.60	2.70	2.04
Nickel [b]	mg/kg dw	0.6	45	18.6	30.8	24.8	23.0
Phosphorus	mg/kg dw	10	na	1,220	994	1,290	1,210
Potassium	mg/kg dw	40	na	402	646	749	529
Selenium [b,d]	mg/kg dw	0.2	1	0.89	1.18	0.82	1.00
Silver [e]	mg/kg dw	0.1	15	0.40	0.76	0.74	0.47
Sodium	mg/kg dw	50	na	83	105	104	76
Strontium	mg/kg dw	0.2	na	33.2	49.3	47.5	43.6
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	1,190	<1,000
Tellurium	mg/kg dw	0.1	na	3.26	4.40	3.30	3.81
Thallium [b]	mg/kg dw	0.1	1	<0.1	0.11	<0.1	0.11

Appendix Table D.6: Metal Concentrations and pH of Soil Sampled at Kemess Underground Study Area 3 (KUG3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling			
				KUG3A	KUG3B	KUG3C	KUG3-COMP
				23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22
Thorium	mg/kg dw	0.5	na	0.66	1.22	0.64	0.81
Tin [b]	mg/kg dw	0.2	5	0.54	0.56	0.49	0.58
Titanium	mg/kg dw	1	na	843	1,420	807	1,160
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.43	0.51	0.50	0.48
Vanadium [c]	mg/kg dw	1	100	88.2	142.0	127.0	107.0
Zinc [d]	mg/kg dw	2	150	114.0	203.0	173.0	137.0
Zirconium	mg/kg dw	2	na	3.2	2.6	<2	2.2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.5: Metal Concentrations and pH of Soil Sampled at Kemess Underground Study Area 2 (KUG2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				KUG2A	KUG2B	KUG2C	KUG2D	KUG2E	KUG2-COMP
				9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22
pH	pH unit	0.1	na	4.71	4.58	6.04	4.93	4.56	4.57
Aluminum	mg/kg dw	40	na	25,500	21,400	39,000	37,900	24,100	26,800
Antimony [e]	mg/kg dw	0.1	15	0.65	0.42	1.66	2.22	0.66	0.54
Arsenic [d]	mg/kg dw	0.3	10	8.68	9.49	16.60	99.90	15.00	13.40
Barium [c]	mg/kg dw	1	350	29	25	32	89	126	31
Beryllium [d]	mg/kg dw	0.1	1	<0.1	<0.1	0.50	0.29	0.12	0.13
Bismuth	mg/kg dw	0.1	na	1.92	2.52	1.66	15.20	2.78	2.80
Boron [b]	mg/kg dw	2	2	<2	<2	<2	<2	<2	<2
Cadmium [d]	mg/kg dw	0.04	1	0.047	0.047	4.630	0.603	0.060	0.129
Calcium	mg/kg dw	100	na	147	433	17,900	1,890	311	654
Chromium [d]	mg/kg dw	1	60	64.5	35.8	13.8	22.4	30.7	53.7
Cobalt [c,d]	mg/kg dw	0.1	25	0.7	0.9	24.2	0.8	1.1	1.9
Copper [b]	mg/kg dw	0.4	63	48.1	35.1	356.0	38.1	36.7	47.4
Iron	mg/kg dw	20	na	46,000	32,800	56,000	19,700	69,800	47,400
Lead [b]	mg/kg dw	0.2	70	19.7	17.4	75.2	642.0	17.7	28.0
Lithium	mg/kg dw	0.1	na	3.5	4.9	21.7	2.4	2.9	5.9
Magnesium	mg/kg dw	10	na	17,900	13,200	19,100	19,900	13,200	18,500
Manganese [c]	mg/kg dw	0.4	2,000	272	303	1,390	1,370	280	451
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	0.054	<0.04	0.217	<0.04	0.043
Molybdenum [b]	mg/kg dw	0.1	5	76.80	18.00	0.66	2.39	61.00	32.80
Nickel [b]	mg/kg dw	0.6	45	14.5	6.6	15.7	3.2	7.6	10.9
Phosphorus	mg/kg dw	10	na	836	1,220	1,270	1,320	1,620	1,320
Potassium	mg/kg dw	40	na	368	246	1,050	251	671	321
Selenium [b,d]	mg/kg dw	0.2	1	7.11	1.62	1.06	7.64	6.10	3.20
Silver [e]	mg/kg dw	0.1	15	1.12	0.88	1.31	3.47	0.77	1.02
Sodium	mg/kg dw	50	na	55	<50	118	<50	121	<50
Strontium	mg/kg dw	0.2	na	16.1	14.5	146.0	26.6	27.3	18.4
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	1,380	<1,000	1,730	<1,000
Tellurium	mg/kg dw	0.1	na	1.64	0.98	1.92	3.48	1.86	1.35
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1	0.11	<0.1

Appendix Table D.5: Metal Concentrations and pH of Soil Sampled at Kemess Underground Study Area 2 (KUG2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				KUG2A	KUG2B	KUG2C	KUG2D	KUG2E	KUG2-COMP
				9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22
Thorium	mg/kg dw	0.5	na	0.69	<0.5	0.58	<0.5	<0.5	<0.5
Tin [b]	mg/kg dw	0.2	5	0.50	0.67	0.58	3.33	0.63	0.77
Titanium	mg/kg dw	1	na	40	85	1,760	855	77	102
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	0.34	<0.2	<0.2	0.26
Uranium [b]	mg/kg dw	0.05	23	0.38	0.30	0.36	1.51	0.48	0.35
Vanadium [c]	mg/kg dw	1	100	84.3	88.0	154.0	108.0	115.0	115.0
Zinc [d]	mg/kg dw	2	150	45.6	64.2	438.0	143.0	51.9	83.6
Zirconium	mg/kg dw	2	na	<2	<2	6.3	7.6	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.4: Metal Concentrations and pH of Soil Sampled at Kemess Underground Study Area 1 (KUG1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				KUG1A	KUG1B	KUG1C	KUG1D	KUG1E	KUG1-COMP
				9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22
pH	pH unit	0.1	na	5.36	5.15	4.96	4.60	4.41	4.87
Aluminum	mg/kg dw	40	na	29,300	34,100	43,500	18,400	14,000	37,700
Antimony [e]	mg/kg dw	0.1	15	0.85	0.68	1.02	1.15	0.29	0.49
Arsenic [d]	mg/kg dw	0.3	10	13.00	6.01	6.97	15.60	5.50	6.71
Barium [c]	mg/kg dw	1	350	48	122	214	44	41	201
Beryllium [d]	mg/kg dw	0.1	1	0.45	0.65	0.41	0.16	<0.1	0.43
Bismuth	mg/kg dw	0.1	na	1.72	0.77	1.20	1.78	1.64	1.04
Boron [b]	mg/kg dw	2	2	<2	<2	<2	<2	<2	<2
Cadmium [d]	mg/kg dw	0.04	1	0.871	0.176	0.108	0.118	<0.04	0.132
Calcium	mg/kg dw	100	na	1,860	2,490	436	478	224	778
Chromium [d]	mg/kg dw	1	60	20.3	13.2	27.4	22.0	8.8	20.9
Cobalt [c,d]	mg/kg dw	0.1	25	23.4	7.3	4.0	2.4	0.6	4.7
Copper [b]	mg/kg dw	0.4	63	155.0	184.0	405.0	57.3	67.7	293.0
Iron	mg/kg dw	20	na	29,000	43,900	67,100	86,000	25,700	61,500
Lead [b]	mg/kg dw	0.2	70	24.0	11.7	10.7	25.6	16.8	11.3
Lithium	mg/kg dw	0.1	na	8.6	11.8	18.5	4.1	2.2	14.1
Magnesium	mg/kg dw	10	na	17,700	10,200	15,400	6,170	6,120	12,800
Manganese [c]	mg/kg dw	0.4	2,000	703	571	510	276	80	563
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	0.050	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	3.32	36.70	29.20	27.50	30.30	28.50
Nickel [b]	mg/kg dw	0.6	45	10.7	10.0	13.5	4.7	2.7	11.1
Phosphorus	mg/kg dw	10	na	1,250	810	1,780	1,240	849	1,670
Potassium	mg/kg dw	40	na	373	1,840	3,260	468	475	2,490
Selenium [b,d]	mg/kg dw	0.2	1	2.19	1.73	2.87	10.40	7.70	2.36
Silver [e]	mg/kg dw	0.1	15	0.55	0.53	0.49	0.45	0.76	0.45
Sodium	mg/kg dw	50	na	111	100	138	<50	<50	117
Strontium	mg/kg dw	0.2	na	20.5	64.4	75.1	21.8	11.7	70.5
Sulfur	mg/kg dw	1,000	na	<1,000	1,450	3,200	<1,000	<1,000	2,720
Tellurium	mg/kg dw	0.1	na	0.92	0.46	0.97	2.19	2.41	0.87
Thallium [b]	mg/kg dw	0.1	1	<0.1	0.20	0.40	0.12	0.12	0.33

Appendix Table D.4: Metal Concentrations and pH of Soil Sampled at Kemess Underground Study Area 1 (KUG1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				KUG1A	KUG1B	KUG1C	KUG1D	KUG1E	KUG1-COMP
				9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22	9-Dec-22
Thorium	mg/kg dw	0.5	na	0.62	0.89	0.96	0.60	<0.5	0.73
Tin [b]	mg/kg dw	0.2	5	0.23	0.86	1.00	1.24	0.44	0.99
Titanium	mg/kg dw	1	na	27	340	367	545	12	210
Tungsten	mg/kg dw	0.2	na	<0.2	0.30	<0.2	0.25	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.60	0.68	0.71	0.44	0.31	0.64
Vanadium [c]	mg/kg dw	1	100	59.5	84.8	142.0	98.8	39.9	124.0
Zinc [d]	mg/kg dw	2	150	230.0	68.7	85.4	44.3	22.4	76.3
Zirconium	mg/kg dw	2	na	<2	<2	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.3: Metal Concentrations and pH of Soil Sampled at Reference Site 3 (REF3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				REF3A	REF3B	REF3C	REF3D	REF3E	REF3-COMP
				9-Sep-22	9-Sep-22	9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22
pH	pH unit	0.1	na	5.45	6.17	4.05	3.96	4.42	4.41
Aluminum	mg/kg dw	40	na	26,000	19,400	16,100	19,000	38,500	27,500
Antimony [e]	mg/kg dw	0.1	15	0.28	0.23	0.20	0.30	0.38	0.34
Arsenic [d]	mg/kg dw	0.3	10	4.03	3.70	2.30	4.71	11.20	9.30
Barium [c]	mg/kg dw	1	350	156	106	263	157	306	200
Beryllium [d]	mg/kg dw	0.1	1	0.41	0.31	0.36	0.37	0.46	0.39
Bismuth	mg/kg dw	0.1	na	0.10	<0.1	0.13	0.13	0.13	0.13
Boron [b]	mg/kg dw	2	2	<2	<4	<2	<3	14.1	6.1
Cadmium [d]	mg/kg dw	0.04	1	0.225	0.143	0.274	0.742	0.110	0.251
Calcium	mg/kg dw	100	na	3,990	5,670	2,220	2,460	3,110	3,530
Chromium [d]	mg/kg dw	1	60	29.1	32.6	12.5	19.6	8.4	10.6
Cobalt [c,d]	mg/kg dw	0.1	25	14.1	8.5	3.4	7.6	10.2	9.2
Copper [b]	mg/kg dw	0.4	63	23.4	14.6	21.6	24.6	28.7	27.3
Iron	mg/kg dw	20	na	28,700	27,300	17,300	25,100	32,900	28,200
Lead [b]	mg/kg dw	0.2	70	6.3	5.4	6.3	6.8	6.5	6.0
Lithium	mg/kg dw	0.1	na	9.8	33.4	8.2	9.9	20.4	15.2
Magnesium	mg/kg dw	10	na	6,450	7,420	1,830	4,680	17,700	12,300
Manganese [c]	mg/kg dw	0.4	2,000	1,460	312	178	436	1,100	889
Mercury [b]	mg/kg dw	0.04	6.6	0.044	<0.04	0.065	<0.04	0.043	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	0.92	1.90	1.08	2.97	4.79	3.85
Nickel [b]	mg/kg dw	0.6	45	21.4	21.3	5.3	10.9	4.7	6.8
Phosphorus	mg/kg dw	10	na	664	339	1,060	1,050	356	592
Potassium	mg/kg dw	40	na	808	915	897	1,400	9,490	4,590
Selenium [b,d]	mg/kg dw	0.2	1	0.25	0.38	<0.2	0.29	<0.2	<0.2
Silver [e]	mg/kg dw	0.1	15	0.20	<0.1	0.61	0.19	<0.1	0.12
Sodium	mg/kg dw	50	na	90	84	81	74	<50	52
Strontium	mg/kg dw	0.2	na	27.8	44.3	45.2	46.4	129.0	66.0
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1	0.21	0.14

Appendix Table D.3: Metal Concentrations and pH of Soil Sampled at Reference Site 3 (REF3) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				REF3A	REF3B	REF3C	REF3D	REF3E	REF3-COMP
				9-Sep-22	9-Sep-22	9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22
Thorium	mg/kg dw	0.5	na	<0.5	0.67	<0.5	<0.5	0.73	<0.5
Tin [b]	mg/kg dw	0.2	5	0.56	0.44	1.00	0.72	0.83	0.72
Titanium	mg/kg dw	1	na	206	467	79	183	94	84
Tungsten	mg/kg dw	0.2	na	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.51	1.12	0.74	2.29	1.28	1.50
Vanadium [c]	mg/kg dw	1	100	69.2	69.5	50.5	78.6	103.0	81.1
Zinc [d]	mg/kg dw	2	150	63.6	43.1	46.2	77.7	111.0	82.6
Zirconium	mg/kg dw	2	na	<2	<2	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.2: Metal Concentrations and pH of Soil Sampled at Reference Site 2 (REF2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				REF2A	REF2B	REF2C	REF2D	REF2E	REF2-COMP
				9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22
pH	pH unit	0.1	na	5.01	5.16	5.64	4.34	4.93	5.00
Aluminum	mg/kg dw	40	na	25,900	27,600	21,700	17,100	22,500	21,300
Antimony [e]	mg/kg dw	0.1	15	0.41	0.29	0.34	0.22	0.20	0.23
Arsenic [d]	mg/kg dw	0.3	10	6.05	10.70	4.70	4.46	9.55	9.52
Barium [c]	mg/kg dw	1	350	53	61	111	62	56	52
Beryllium [d]	mg/kg dw	0.1	1	0.32	0.43	0.39	0.23	0.45	0.47
Bismuth	mg/kg dw	0.1	na	0.18	0.55	<0.1	0.11	0.17	0.17
Boron [b]	mg/kg dw	2	2	<2	<2	<3	<2	<3	2.4
Cadmium [d]	mg/kg dw	0.04	1	0.201	0.208	0.221	0.168	1.830	1.970
Calcium	mg/kg dw	100	na	2,090	5,560	5,100	2,320	12,000	10,400
Chromium [d]	mg/kg dw	1	60	42.2	39.3	37.3	32.5	85.1	92.0
Cobalt [c,d]	mg/kg dw	0.1	25	8.6	9.9	9.9	6.1	21.9	26.0
Copper [b]	mg/kg dw	0.4	63	21.0	27.0	26.3	16.2	42.0	40.0
Iron	mg/kg dw	20	na	42,300	37,200	29,500	23,500	32,900	32,100
Lead [b]	mg/kg dw	0.2	70	8.5	6.7	6.2	7.0	11.5	12.8
Lithium	mg/kg dw	0.1	na	8.2	10.9	10.3	5.7	7.1	5.5
Magnesium	mg/kg dw	10	na	5,510	6,710	6,590	4,340	13,800	12,000
Manganese [c]	mg/kg dw	0.4	2,000	643	695	446	400	1,010	965
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	<0.04	0.063	<0.04	<0.04
Molybdenum [b]	mg/kg dw	0.1	5	1.31	1.83	1.72	0.84	1.59	2.00
Nickel [b]	mg/kg dw	0.6	45	15.6	21.0	22.2	13.1	48.0	53.1
Phosphorus	mg/kg dw	10	na	678	544	551	784	731	689
Potassium	mg/kg dw	40	na	588	563	654	545	532	532
Selenium [b,d]	mg/kg dw	0.2	1	0.26	0.28	0.31	0.29	0.29	0.38
Silver [e]	mg/kg dw	0.1	15	0.20	0.14	0.13	0.23	0.13	0.14
Sodium	mg/kg dw	50	na	101	90	113	76	130	104
Strontium	mg/kg dw	0.2	na	23.6	37.3	35.9	23.6	58.8	59.5
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	0.15	<0.1	<0.1	<0.1	<0.1
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.2: Metal Concentrations and pH of Soil Sampled at Reference Site 2 (REF2) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				REF2A	REF2B	REF2C	REF2D	REF2E	REF2-COMP
				9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22	9-Nov-22
Thorium	mg/kg dw	0.5	na	1.26	1.11	0.56	<0.5	<0.5	<0.5
Tin [b]	mg/kg dw	0.2	5	1.56	1.06	0.55	0.63	0.47	0.51
Titanium	mg/kg dw	1	na	1,220	1,490	735	587	1,060	756
Tungsten	mg/kg dw	0.2	na	<0.2	0.28	<0.2	<0.2	<0.2	<0.2
Uranium [b]	mg/kg dw	0.05	23	0.44	0.42	0.43	0.40	0.67	0.68
Vanadium [c]	mg/kg dw	1	100	109.0	86.7	77.7	67.5	64.0	58.3
Zinc [d]	mg/kg dw	2	150	65.3	71.7	60.5	33.9	175.0	158.0
Zirconium	mg/kg dw	2	na	2.3	2.2	<2	<2	<2	<2

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

Appendix Table D.1: Metal Concentrations and pH of Soil Sampled at Reference Site 1 (REF1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				REF1A	REF1B	REF1C	REF1D	REF1E	REF1-COMP
				9-Oct-22	9-Oct-22	9-Oct-22	9-Oct-22	9-Oct-22	9-Oct-22
pH	pH unit	0.1	na	5.03	5.17	4.50	4.87	5.40	5.24
Aluminum	mg/kg dw	40	na	17,300	13,400	17,800	23,700	29,100	25,600
Antimony [e]	mg/kg dw	0.1	15	0.78	0.94	0.47	0.41	0.86	0.86
Arsenic [d]	mg/kg dw	0.3	10	9.36	7.34	4.39	5.20	11.10	9.75
Barium [c]	mg/kg dw	1	350	100	66	55	126	50	66
Beryllium [d]	mg/kg dw	0.1	1	0.34	0.30	0.28	0.41	0.68	0.56
Bismuth	mg/kg dw	0.1	na	<0.1	<0.1	0.36	0.30	1.08	0.77
Boron [b]	mg/kg dw	2	2	<2	<2	<2	<2	<2	<2
Cadmium [d]	mg/kg dw	0.04	1	0.406	0.405	0.140	0.434	0.349	0.400
Calcium	mg/kg dw	100	na	5,150	6,980	783	2,140	1,180	2,380
Chromium [d]	mg/kg dw	1	60	18.6	11.7	16.8	21.2	24.1	22.1
Cobalt [c,d]	mg/kg dw	0.1	25	10.2	7.9	4.3	7.0	8.4	9.4
Copper [b]	mg/kg dw	0.4	63	26.9	13.9	42.2	34.5	228.0	160.0
Iron	mg/kg dw	20	na	29,300	29,900	78,900	38,400	139,000	98,300
Lead [b]	mg/kg dw	0.2	70	9.6	8.5	12.0	11.5	26.0	20.6
Lithium	mg/kg dw	0.1	na	13.1	11.0	5.9	8.9	7.6	8.5
Magnesium	mg/kg dw	10	na	8,100	6,990	2,320	5,290	6,300	6,230
Manganese [c]	mg/kg dw	0.4	2,000	714	589	451	352	319	404
Mercury [b]	mg/kg dw	0.04	6.6	<0.04	<0.04	0.042	0.043	0.044	0.040
Molybdenum [b]	mg/kg dw	0.1	5	0.56	0.43	4.43	1.77	17.80	12.00
Nickel [b]	mg/kg dw	0.6	45	13.6	7.8	4.2	10.6	9.8	10.4
Phosphorus	mg/kg dw	10	na	738	685	852	763	970	870
Potassium	mg/kg dw	40	na	803	785	348	613	328	449
Selenium [b,d]	mg/kg dw	0.2	1	<0.2	<0.2	0.26	0.23	2.94	1.83
Silver [e]	mg/kg dw	0.1	15	<0.1	<0.1	0.13	0.42	0.35	0.26
Sodium	mg/kg dw	50	na	106	100	78	121	63	75
Strontium	mg/kg dw	0.2	na	51.9	47.2	12.8	33.4	24.3	31.2
Sulfur	mg/kg dw	1,000	na	<1,000	<1,000	<1,000	<1,000	1,310	<1,000
Tellurium	mg/kg dw	0.1	na	<0.1	<0.1	0.18	0.15	0.87	0.51
Thallium [b]	mg/kg dw	0.1	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Appendix Table D.1: Metal Concentrations and pH of Soil Sampled at Reference Site 1 (REF1) in 2022

Parameter	Units	Method Detection Limit	Soil Quality Guideline[a]	Replicate and Date of Sampling					
				REF1A	REF1B	REF1C	REF1D	REF1E	REF1-COMP
				9-Oct-22	9-Oct-22	9-Oct-22	9-Oct-22	9-Oct-22	9-Oct-22
Thorium	mg/kg dw	0.5	na	1.54	1.61	1.18	1.05	2.38	1.92
Tin [b]	mg/kg dw	0.2	5	0.39	0.42	1.24	0.90	0.82	0.71
Titanium	mg/kg dw	1	na	707	736	469	612	639	614
Tungsten	mg/kg dw	0.2	na	<0.2	0.21	0.24	0.23	0.29	0.25
Uranium [b]	mg/kg dw	0.05	23	0.65	0.81	0.38	0.61	2.30	2.15
Vanadium [c]	mg/kg dw	1	100	70.3	75.1	129.0	89.1	91.8	84.1
Zinc [d]	mg/kg dw	2	150	64.6	52.4	49.5	47.3	76.9	69.0
Zirconium	mg/kg dw	2	na	<2	2.9	<2	<2	18.6	6.3

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

[b] Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes

[c] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants

[d] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life

[e] British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Generic Numerical Soil Standards Protect Ecological Health (BC Reg. 375/96 Schedule 3.1, Part 3) within Natural Wildlands

APPENDIX E

Vegetation Chemistry Tables and Laboratory Data

Appendix Table E.13: Dry Weight and Metal Concentrations of Vegetation Sampled at Omineca Resource Access Road Study Area 3 (RD3) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		RD3A-LICHEN	RD3A-RED WILLOW	RD3A-SEDGE	RD3B-LICHEN	RD3B-RED WILLOW	RD3B-SEDGE	RD3C-LICHEN	RD3C-RED WILLOW	RD3C-SEDGE	RD3-LICHEN COMP	RD3-RED WILLOW COMP	RD3-SEDGE COMP
		25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Dry Weight	%	28.1	33.6	36.9	20.8	38.8	32.9	27.2	37.9	42.0	23.6	34.3	35.7
Aluminum	mg/kg dw	2,000	277	90	565	65	120	1,800	245	78	1,520	179	102
Antimony	mg/kg dw	0.0211	0.0127	<0.0108	0.0203	<0.0103	<0.0096	0.0498	<0.0106	<0.0095	0.0247	<0.0117	<0.0112
Arsenic	mg/kg dw	0.1970	0.1020	0.0305	0.1350	<0.0258	0.0357	0.4610	0.0728	0.0258	0.2360	0.0483	0.0367
Barium	mg/kg dw	32.7	86.7	40.1	72.1	69.6	70.7	84.6	33.9	63.9	70.5	49.7	48.0
Beryllium	mg/kg dw	0.0829	<0.0098	<0.0108	<0.0103	<0.0103	<0.0096	0.0210	<0.0106	<0.0095	0.0431	<0.0117	<0.0112
Bismuth	mg/kg dw	<0.1	<0.098	<0.108	<0.103	<0.103	<0.096	<0.098	<0.106	<0.095	<0.1	<0.117	<0.112
Boron	mg/kg dw	1.51	4.94	2.43	10.70	8.64	3.99	5.25	9.65	3.80	4.47	7.84	2.97
Cadmium	mg/kg dw	0.262	4.130	0.311	0.218	7.790	0.170	1.310	3.990	0.175	0.682	4.820	0.158
Calcium	mg/kg dw	3,640	20,100	4,410	11,700	19,700	5,310	8,930	14,400	7,130	8,360	16,200	5,370
Chromium	mg/kg dw	31.300	30.700	29.000	53.600	16.000	25.300	32.500	46.300	13.800	28.100	19.500	27.200
Cobalt	mg/kg dw	0.661	1.540	0.108	0.410	1.920	0.183	1.450	0.466	0.082	0.747	1.140	0.125
Copper	mg/kg dw	7.81	13.40	3.77	8.89	9.67	5.84	11.30	7.08	3.88	10.00	7.15	4.55
Iron	mg/kg dw	913	453	150	733	127	191	2,670	401	139	1,260	298	183
Lead	mg/kg dw	0.186	0.068	0.058	0.175	0.023	0.048	0.521	0.053	0.030	0.273	0.042	0.041
Magnesium	mg/kg dw	1,580	7,210	1,790	2,790	4,880	1,850	2,650	4,320	1,550	2,580	5,240	1,760
Manganese	mg/kg dw	343	457	764	358	109	447	655	256	234	724	322	610
Mercury	mg/kg dw	0.021	0.019	<0.0108	0.036	<0.0103	0.011	0.047	0.016	0.011	0.034	0.016	<0.0112
Molybdenum	mg/kg dw	1.890	0.869	1.340	0.897	0.235	1.410	1.740	0.522	2.260	1.390	0.586	3.340
Nickel	mg/kg dw	2.310	5.140	2.970	2.100	5.440	2.890	6.790	6.270	4.200	4.080	6.300	4.100
Phosphorus	mg/kg dw	1,100	2,050	1,170	1,860	2,740	1,980	1,570	4,020	1,830	1,630	3,440	1,900
Potassium	mg/kg dw	4,080	6,130	7,320	3,750	5,820	13,400	3,520	12,400	15,300	4,670	9,220	11,700
Selenium	mg/kg dw	<0.1	<0.098	<0.108	0.430	0.412	0.434	0.892	1.450	1.000	0.601	0.702	0.409
Silver	mg/kg dw	0.392	<0.049	<0.054	<0.051	<0.052	<0.048	0.062	<0.053	<0.048	0.229	<0.058	<0.056
Sodium	mg/kg dw	26.3	<9.8	<10.8	20.0	<10.3	10.6	51.8	<10.6	<9.5	37.3	<11.7	<11.2
Strontium	mg/kg dw	14.5	91.9	17.8	45.2	86.7	22.3	33.3	49.9	29.4	32.8	62.2	21.4
Thallium	mg/kg dw	<0.005	<0.0049	<0.0054	0.0073	<0.0052	0.0091	0.0202	0.0090	<0.0048	0.0086	0.0067	<0.0056
Tin	mg/kg dw	<0.1	0.342	<0.108	<0.103	<0.103	<0.096	<0.098	<0.106	<0.095	<0.1	<0.117	<0.112
Titanium	mg/kg dw	24.50	17.40	5.52	24.40	4.44	6.51	109.00	20.10	4.33	41.80	13.30	6.67
Uranium	mg/kg dw	0.0230	0.0087	<0.0054	0.0150	<0.0052	<0.0048	0.0574	0.0068	<0.0048	0.0253	<0.0058	<0.0056
Vanadium	mg/kg dw	2.430	1.060	0.273	1.810	0.231	0.358	7.100	0.963	0.269	3.160	0.687	0.357
Zinc	mg/kg dw	29.9	319.0	19.6	50.7	298.0	56.2	91.3	206.0	41.7	65.0	264.0	32.5

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.12: Dry Weight and Metal Concentrations of Vegetation Sampled at Omineca Resource Access Road Study Area 2 (RD2) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		RD2A-LICHEN	RD2A-RED WILLOW	RD2A-SEDGE	RD2B-LICHEN	RD2B-RED WILLOW	RD2B-SEDGE	RD2C-LICHEN	RD2C-RED WILLOW	RD2C-SEDGE	RD2-LICHEN COMP	RD2-RED WILLOW COMP	RD2-SEDGE COMP
		24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
Dry Weight	%	45.2	34.5	42.4	23.3	41.4	40.6	25.6	36.1	39.1	22.9	34.3	36.7
Aluminum	mg/kg dw	444	40	56	703	22	168	918	43	361	321	40	115
Antimony	mg/kg dw	0.0089	<0.0096	<0.0094	0.0211	<0.0097	<0.0099	0.0196	<0.0111	0.0285	0.0142	<0.0116	<0.0109
Arsenic	mg/kg dw	0.0566	<0.024	<0.0236	0.1250	<0.0241	0.0359	0.1750	<0.0277	0.0676	0.0519	<0.0291	<0.0272
Barium	mg/kg dw	7.2	43.3	45.3	21.7	46.0	46.8	45.0	36.8	49.5	19.8	44.9	47.6
Beryllium	mg/kg dw	<0.0089	<0.0096	<0.0094	0.0134	<0.0097	<0.0099	0.0162	<0.0111	<0.0102	<0.0086	<0.0116	<0.0109
Bismuth	mg/kg dw	<0.089	<0.096	<0.094	<0.097	<0.097	<0.099	<0.078	<0.111	<0.102	<0.086	<0.116	<0.109
Boron	mg/kg dw	2.31	9.04	4.41	4.62	15.50	4.40	1.76	6.29	2.85	3.73	9.41	4.03
Cadmium	mg/kg dw	0.279	0.788	0.099	0.836	2.050	0.191	0.364	0.460	0.136	0.453	0.929	0.101
Calcium	mg/kg dw	3,390	17,200	4,390	5,900	14,900	4,050	7,480	15,000	4,280	6,040	21,200	5,050
Chromium	mg/kg dw	0.797	0.311	0.978	0.982	0.230	0.965	1.510	0.355	1.570	0.368	0.129	0.823
Cobalt	mg/kg dw	0.198	1.130	0.088	0.415	1.400	0.267	0.790	0.699	0.380	0.347	1.890	0.134
Copper	mg/kg dw	3.68	5.78	3.38	6.39	6.46	4.71	6.32	3.37	6.07	4.14	5.41	4.06
Iron	mg/kg dw	353	72	70	665	51	237	976	64	403	228	82	166
Lead	mg/kg dw	0.137	<0.0192	0.023	0.361	0.029	0.093	0.332	<0.0222	5.420	0.126	<0.0233	0.046
Magnesium	mg/kg dw	911	3,010	754	1,300	2,540	683	1,250	2,590	726	1,260	3,370	825
Manganese	mg/kg dw	331	127	1,350	592	288	1,520	527	113	963	432	242	1,190
Mercury	mg/kg dw	0.041	0.011	0.018	0.052	0.011	0.022	0.041	0.013	0.025	0.036	0.015	0.015
Molybdenum	mg/kg dw	0.147	0.223	0.843	0.521	0.148	1.310	0.446	0.208	0.952	0.174	0.294	1.660
Nickel	mg/kg dw	1.650	3.480	0.739	1.760	3.320	1.020	2.520	1.530	1.400	1.550	4.590	0.866
Phosphorus	mg/kg dw	945	2,630	1,210	1,280	2,740	1,250	1,150	3,250	1,080	1,310	3,480	1,820
Potassium	mg/kg dw	3,250	9,340	10,300	3,110	7,420	7,440	3,170	10,100	6,580	4,170	11,700	13,500
Selenium	mg/kg dw	<0.089	<0.096	<0.094	<0.097	<0.097	<0.099	0.089	<0.111	<0.102	<0.086	<0.116	<0.109
Silver	mg/kg dw	<0.044	<0.048	<0.047	0.103	<0.048	<0.049	<0.039	<0.055	<0.051	<0.043	<0.058	<0.054
Sodium	mg/kg dw	20.9	<9.6	<9.4	14.4	<9.7	<9.9	10.5	<11.1	<10.2	30.0	15.0	<10.9
Strontium	mg/kg dw	6.4	67.1	15.0	15.7	59.4	14.6	27.8	57.3	15.2	16.5	79.9	18.9
Thallium	mg/kg dw	<0.0044	<0.0048	<0.0047	<0.0048	<0.0048	<0.0049	0.0048	<0.0055	<0.0051	<0.0043	<0.0058	<0.0054
Tin	mg/kg dw	<0.089	<0.096	<0.094	<0.097	<0.097	<0.099	<0.078	<0.111	<0.102	<0.086	<0.116	<0.109
Titanium	mg/kg dw	13.90	2.37	2.23	25.00	1.27	9.36	42.00	2.01	18.10	8.65	2.27	7.32
Uranium	mg/kg dw	0.0052	<0.0048	<0.0047	0.0136	<0.0048	<0.0049	0.0235	<0.0055	0.0094	0.0049	<0.0058	<0.0054
Vanadium	mg/kg dw	0.773	<0.096	<0.094	1.550	<0.097	0.474	2.240	<0.111	0.874	0.469	<0.116	0.327
Zinc	mg/kg dw	31.6	95.7	17.5	52.9	94.0	31.6	39.6	77.3	27.8	45.3	115.0	23.8

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.11: Dry Weight and Metal Concentrations of Vegetation Sampled at Omineca Resource Access Road Study Area 1 (RD1) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		RD1A-LICHEN	RD1A-Red WILLOW	RD1A-SEDGE	RD1B-LICHEN	RD1B-RED WILLOW	RD1B-SEDGE	RD1C-LICHEN	RD1C-RED WILLOW	RD1C-SEDGE	RD1-LICHEN COMP	RD1-RED WILLOW COMP	RD1-SEDGE COMP
		24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
Dry Weight	%	49.7	35.9	41.9	17.8	31.9	31.0	23.0	37.1	38.7	26.1	34.3	42.4
Aluminum	mg/kg dw	13,900	95	1,620	370	64	36	284	25	73	3,720	64	400
Antimony	mg/kg dw	0.1720	<0.0112	0.0609	0.0200	<0.01	<0.0102	0.0404	<0.0108	0.0144	0.1060	<0.0093	0.0176
Arsenic	mg/kg dw	3.2100	0.0337	0.5770	0.1070	<0.0249	<0.0255	0.0869	<0.027	0.0316	0.9360	0.0292	0.1290
Barium	mg/kg dw	85.1	45.2	43.5	46.0	35.2	30.2	71.1	27.6	49.0	86.6	45.9	44.5
Beryllium	mg/kg dw	0.2610	<0.0112	0.0364	<0.0112	<0.01	<0.0102	<0.0087	<0.0108	<0.0103	0.0655	<0.0093	0.0106
Bismuth	mg/kg dw	<0.08	<0.112	<0.096	<0.112	<0.1	<0.102	<0.087	<0.108	<0.103	<0.076	<0.093	<0.094
Boron	mg/kg dw	2.48	32.40	4.98	5.95	18.40	5.37	8.67	16.20	8.77	5.05	20.90	6.70
Cadmium	mg/kg dw	0.236	1.690	1.160	0.185	2.280	0.177	0.210	2.840	0.130	0.265	2.320	0.470
Calcium	mg/kg dw	7,590	16,300	5,810	10,500	16,900	5,550	10,900	13,500	5,310	9,820	17,600	5,260
Chromium	mg/kg dw	35.000	0.468	4.370	1.050	0.376	1.250	0.670	0.237	1.260	9.380	0.483	1.460
Cobalt	mg/kg dw	9.410	1.370	1.150	0.610	3.190	0.327	1.190	5.510	0.336	2.260	2.950	0.668
Copper	mg/kg dw	25.90	5.05	13.70	7.28	8.73	6.65	10.30	8.63	6.33	18.90	6.62	6.18
Iron	mg/kg dw	22,500	155	2,210	453	129	85	366	68	142	4,900	117	505
Lead	mg/kg dw	3.030	0.045	0.530	0.190	0.040	0.036	0.209	0.028	0.063	0.985	0.036	0.153
Magnesium	mg/kg dw	8,470	3,170	1,500	1,670	3,700	1,100	1,260	2,790	803	2,620	3,580	884
Manganese	mg/kg dw	490	114	392	225	139	601	427	122	1,040	448	140	955
Mercury	mg/kg dw	0.017	0.012	0.016	0.032	0.012	0.013	0.045	<0.0108	0.026	0.048	0.015	0.015
Molybdenum	mg/kg dw	0.915	0.995	1.730	1.050	0.379	0.797	0.405	0.388	0.495	0.880	0.561	2.080
Nickel	mg/kg dw	20.300	2.820	3.450	1.710	6.510	1.790	1.290	3.950	1.060	6.030	3.900	1.810
Phosphorus	mg/kg dw	780	3,420	1,430	1,510	1,570	1,510	1,360	1,560	1,890	1,180	2,170	1,530
Potassium	mg/kg dw	1,670	10,100	9,280	5,520	11,700	13,600	4,060	9,410	13,700	3,480	11,400	12,100
Selenium	mg/kg dw	0.108	<0.112	0.192	<0.112	<0.1	<0.102	<0.087	0.124	<0.103	0.087	<0.093	<0.094
Silver	mg/kg dw	<0.04	<0.056	<0.048	<0.056	<0.05	<0.051	<0.043	<0.054	<0.052	0.045	<0.047	<0.047
Sodium	mg/kg dw	93.9	<11.2	22.9	28.9	<10	11.3	21.1	29.9	12.9	32.8	<9.3	12.4
Strontium	mg/kg dw	49.2	72.8	28.4	42.8	51.0	19.2	38.7	42.3	20.2	41.6	65.1	21.2
Thallium	mg/kg dw	0.0249	<0.0056	0.0064	<0.0056	<0.005	<0.0051	<0.0043	<0.0054	<0.0052	0.0111	<0.0047	<0.0047
Tin	mg/kg dw	0.321	<0.112	0.216	<0.112	<0.1	<0.102	<0.087	<0.108	<0.103	0.079	<0.093	<0.094
Titanium	mg/kg dw	987.00	6.87	106.00	20.20	3.89	2.33	15.80	1.77	4.03	241.00	3.98	23.30
Uranium	mg/kg dw	0.3550	<0.0056	0.0519	0.0095	<0.005	<0.0051	0.0087	<0.0054	<0.0052	0.0788	<0.0047	0.0122
Vanadium	mg/kg dw	65.300	0.286	5.810	0.985	0.173	0.106	0.774	<0.108	0.224	12.300	0.157	1.260
Zinc	mg/kg dw	49.4	88.5	45.5	25.6	120.0	23.0	48.2	117.0	34.0	47.5	113.0	54.1

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.10: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess South Study Area 4 (KS4) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		KS4A-LICHEN	KS4A-RED WILLOW	KS4A-SEDGE	KS4B-LICHEN	KS4B-RED WILLOW	KS4B-SEDGE	KS4C-LICHEN	KS4C-RED WILLOW	KS4C-SEDGE	KS4-LICHEN COMP	KS4-RED WILLOW COMP	KS4-SEDGE COMP
		24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22	24-Sep-22
Dry Weight	%	23.3	88.8	28.0	47.6	30.1	28.2	26.6	32.5	37.0	29.5	28.6	35.7
Aluminum	mg/kg dw	5,180	44	1,420	1,640	37	78	1,420	57	147	1,970	86	99
Antimony	mg/kg dw	0.2560	<0.0085	0.0522	0.2490	<0.0099	0.0162	0.1810	<0.0101	0.0116	0.1640	<0.01	0.0155
Arsenic	mg/kg dw	9.1700	0.1260	1.3600	0.6810	0.0435	0.0617	0.5130	0.0695	0.0811	2.3300	0.0919	0.1510
Barium	mg/kg dw	74.9	19.4	23.8	131.0	28.8	35.7	48.5	20.2	68.6	69.4	37.6	30.0
Beryllium	mg/kg dw	0.1150	<0.0085	0.0315	0.0480	<0.0099	<0.0101	0.0363	<0.0101	<0.0108	0.0526	<0.01	<0.0112
Bismuth	mg/kg dw	<0.086	<0.085	<0.098	<0.084	<0.099	<0.101	<0.101	<0.101	<0.108	<0.1	<0.1	<0.112
Boron	mg/kg dw	3.18	22.20	4.37	7.62	13.40	5.18	5.68	36.80	8.34	5.29	38.30	4.53
Cadmium	mg/kg dw	0.348	0.637	0.051	0.356	0.485	0.211	0.760	1.670	0.252	0.293	1.320	0.117
Calcium	mg/kg dw	11,000	21,700	5,710	14,700	23,200	4,120	5,970	17,800	6,630	9,300	26,300	3,760
Chromium	mg/kg dw	11.600	0.357	3.520	1.360	0.413	0.740	1.700	0.373	1.280	3.900	0.440	0.914
Cobalt	mg/kg dw	3.280	0.264	0.826	0.896	3.060	0.087	0.862	0.513	0.174	1.390	1.500	0.115
Copper	mg/kg dw	28.40	6.46	7.98	39.40	7.28	6.46	30.30	8.64	6.86	27.20	8.52	4.97
Iron	mg/kg dw	8,280	80	1,990	1,730	72	121	1,450	91	173	2,900	141	165
Lead	mg/kg dw	2.170	0.029	0.453	1.200	0.030	0.057	1.030	0.038	0.099	1.090	0.055	0.058
Magnesium	mg/kg dw	3,200	2,260	1,400	1,470	2,400	926	1,240	1,970	1,020	1,940	2,820	790
Manganese	mg/kg dw	412	114	418	839	89	1,060	416	94	1,360	505	144	662
Mercury	mg/kg dw	0.030	0.012	0.017	0.089	0.014	0.018	0.058	0.013	0.034	0.049	0.017	0.013
Molybdenum	mg/kg dw	3.750	1.270	3.120	2.190	0.555	0.610	1.630	0.595	1.540	2.780	0.852	2.290
Nickel	mg/kg dw	6.460	0.771	2.050	1.610	1.740	1.040	1.770	2.260	0.659	2.800	3.140	0.895
Phosphorus	mg/kg dw	1,400	2,070	1,010	1,240	1,170	1,390	1,070	1,030	1,270	1,400	1,930	1,230
Potassium	mg/kg dw	4,600	9,880	10,200	4,200	9,090	13,900	3,440	11,500	9,550	5,210	13,100	11,100
Selenium	mg/kg dw	0.698	0.229	0.215	0.186	0.150	<0.101	0.182	0.115	<0.108	0.245	0.143	<0.112
Silver	mg/kg dw	0.059	<0.043	<0.049	0.076	<0.049	<0.05	0.052	<0.051	<0.054	<0.05	<0.05	<0.056
Sodium	mg/kg dw	61.4	<8.5	18.4	22.4	<9.9	<10.1	22.8	<10.1	<10.8	36.1	<10	<11.2
Strontium	mg/kg dw	39.5	58.9	20.3	48.4	60.8	12.9	15.5	47.0	19.0	32.9	72.4	10.6
Thallium	mg/kg dw	0.0166	<0.0043	<0.0049	0.0182	<0.0049	<0.005	0.0155	<0.0051	<0.0054	0.0127	<0.005	<0.0056
Tin	mg/kg dw	0.207	<0.085	<0.098	<0.084	<0.099	<0.101	<0.101	<0.101	<0.108	<0.1	<0.1	<0.112
Titanium	mg/kg dw	260.00	2.50	97.00	39.00	2.07	3.17	38.00	2.80	4.55	81.10	4.37	5.75
Uranium	mg/kg dw	0.3420	<0.0043	0.0561	0.0595	<0.0049	<0.005	0.0446	<0.0051	<0.0054	0.1130	<0.005	<0.0056
Vanadium	mg/kg dw	20.400	0.109	5.320	3.940	<0.099	0.174	3.150	0.129	0.283	6.890	0.221	0.290
Zinc	mg/kg dw	55.7	119.0	54.1	75.9	67.8	19.7	49.1	112.0	30.5	51.9	145.0	32.3

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.9: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess South Study Area 3 (KS3) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		KS3A-LICHEN	KS3A-RED WILLOW	KS3A-SEDGE	KS3B-LICHEN	KS3B-RED WILLOW	KS3B-SEDGE	KS3C-LICHEN	KS3C-RED WILLOW	KS3C-SEDGE	KS3-LICHEN COMP	KS3-RED WILLOW COMP	KS3-SEDGE COMP
		25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Dry Weight	%	16.0	29.8	26.9	18.3	31.6	24.3	18.3	32.5	26.7	20.6	30.0	26.4
Aluminum	mg/kg dw	517	78	38	231	43	48	1,180	75	94	2,150	94	264
Antimony	mg/kg dw	0.0200	0.0097	0.0080	0.0161	<0.0101	0.0140	0.0712	<0.0097	0.0133	0.0715	0.0114	0.0265
Arsenic	mg/kg dw	0.0903	<0.0241	<0.0185	0.1010	<0.0254	0.0359	0.1410	<0.0242	<0.0185	0.3600	<0.0252	0.0720
Barium	mg/kg dw	58.6	60.5	29.1	152.0	62.6	56.4	75.6	151.0	69.8	96.6	81.8	79.0
Beryllium	mg/kg dw	0.0211	0.0126	<0.0074	0.0226	0.0266	<0.0082	0.0699	0.0224	<0.0074	0.0899	0.0238	0.0155
Bismuth	mg/kg dw	<0.101	<0.096	<0.074	<0.109	<0.101	<0.082	<0.109	<0.097	<0.074	<0.097	<0.101	<0.076
Boron	mg/kg dw	4.95	24.80	6.67	7.89	6.00	5.76	1.63	7.37	2.14	3.07	14.50	3.71
Cadmium	mg/kg dw	0.395	2.820	0.051	2.280	7.320	0.462	0.403	2.750	0.187	0.329	3.470	0.141
Calcium	mg/kg dw	6,270	13,700	3,160	13,500	17,400	5,720	4,150	15,400	3,160	5,420	16,300	3,870
Chromium	mg/kg dw	0.629	0.073	0.347	0.443	0.142	0.309	0.460	0.094	0.551	1.510	0.140	0.873
Cobalt	mg/kg dw	0.433	2.090	0.086	0.761	3.930	0.248	0.431	2.730	0.084	0.965	2.940	0.332
Copper	mg/kg dw	8.25	4.71	3.76	13.00	6.69	6.42	11.80	5.00	7.62	16.60	4.95	7.68
Iron	mg/kg dw	544	42	70	339	44	102	481	42	81	1,810	63	367
Lead	mg/kg dw	0.251	0.033	0.058	0.216	0.022	0.054	0.434	0.034	0.058	0.737	0.028	0.110
Magnesium	mg/kg dw	1,890	2,190	651	2,280	2,680	938	1,000	3,070	461	1,620	2,870	633
Manganese	mg/kg dw	297	271	843	1,470	341	574	944	209	1,030	1,050	238	999
Mercury	mg/kg dw	0.023	<0.0096	0.011	0.040	<0.0101	0.016	0.046	0.013	0.017	0.036	0.011	0.015
Molybdenum	mg/kg dw	0.414	0.354	1.160	1.630	0.612	0.948	1.390	0.293	2.560	1.990	0.455	2.100
Nickel	mg/kg dw	0.669	1.390	0.421	1.630	5.890	0.595	1.310	2.260	0.540	1.880	3.660	0.764
Phosphorus	mg/kg dw	1,670	3,430	1,440	2,440	1,670	1,070	1,270	1,810	1,610	1,420	2,150	1,550
Potassium	mg/kg dw	11,100	14,400	8,100	6,400	10,100	9,790	3,270	10,700	6,590	4,610	12,000	8,900
Selenium	mg/kg dw	<0.101	<0.096	<0.074	<0.109	<0.101	<0.082	<0.109	<0.097	<0.074	0.103	<0.101	<0.076
Silver	mg/kg dw	0.079	<0.048	<0.037	<0.055	<0.051	<0.041	0.457	<0.048	<0.037	0.173	<0.05	<0.038
Sodium	mg/kg dw	46.1	27.8	20.9	19.4	16.4	25.5	17.8	10.7	11.8	26.3	<10.1	17.8
Strontium	mg/kg dw	40.3	81.5	16.8	77.0	90.2	29.2	23.9	175.0	23.9	34.8	112.0	31.5
Thallium	mg/kg dw	<0.005	<0.0048	<0.0037	<0.0055	<0.0051	<0.0041	0.0065	<0.0048	0.0060	0.0116	<0.005	0.0043
Tin	mg/kg dw	<0.101	<0.096	<0.074	<0.109	<0.101	<0.082	<0.109	<0.097	<0.074	<0.097	<0.101	<0.076
Titanium	mg/kg dw	22.90	0.53	2.41	6.85	0.59	2.25	9.90	0.55	1.52	31.10	1.69	8.74
Uranium	mg/kg dw	0.0110	<0.0048	<0.0037	0.0086	<0.0051	<0.0041	0.0155	<0.0048	<0.0037	0.0457	<0.005	0.0091
Vanadium	mg/kg dw	1.360	<0.096	0.098	0.563	<0.101	0.132	0.843	<0.097	0.078	5.000	<0.101	0.997
Zinc	mg/kg dw	57.1	127.0	32.2	174.0	156.0	39.9	40.0	153.0	46.3	47.2	149.0	38.4

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.8: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess South Study Area 2 (KS2) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		KS2A-LICHEN	KS2A-RED WILLOW	KS2A-SEDGE	KS2B-LICHEN	KS2B-RED WILLOW	KS2B-SEDGE	KS2C-LICHEN	KS2C-RED WILLOW	KS2C-SEDGE	KS2-LICHEN COMP	KS2-RED WILLOW COMP	KS2-SEDGE COMP
		25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Dry Weight	%	19.7	32.2	31.0	15.3	29.8	21.7	14.7	38.6	18.3	15.4	31.0	24.0
Aluminum	mg/kg dw	265	58	25	133	13	18	161	7	57	628	17	52
Antimony	mg/kg dw	0.0188	0.0148	<0.01	0.0220	<0.0066	0.0167	0.0256	<0.0104	0.0142	0.0756	0.0120	0.0198
Arsenic	mg/kg dw	0.0831	0.0331	<0.0249	0.1080	0.0387	0.0251	0.0813	<0.0259	0.0357	0.2210	<0.0248	0.0292
Barium	mg/kg dw	38.6	74.3	57.6	55.0	11.6	44.8	35.2	25.8	69.0	71.8	24.1	60.0
Beryllium	mg/kg dw	0.0111	0.0128	<0.01	<0.0099	<0.0066	<0.0092	<0.0101	<0.0104	<0.0108	0.0349	<0.0099	<0.0098
Bismuth	mg/kg dw	<0.102	<0.098	<0.1	<0.099	<0.066	<0.092	<0.101	<0.104	<0.108	<0.129	<0.099	<0.098
Boron	mg/kg dw	<1.02	11.80	2.59	5.80	11.50	5.00	3.48	14.10	6.48	2.99	12.80	5.68
Cadmium	mg/kg dw	0.147	0.637	0.067	0.166	0.598	0.143	1.950	4.790	0.527	0.303	0.983	0.147
Calcium	mg/kg dw	5,650	16,200	4,890	12,900	9,940	6,850	7,780	12,100	7,560	12,500	17,400	7,040
Chromium	mg/kg dw	0.282	0.140	0.483	0.290	0.062	0.446	0.253	0.102	0.488	0.816	0.103	0.698
Cobalt	mg/kg dw	0.370	3.730	0.124	0.183	0.408	0.054	0.161	0.270	0.104	1.010	1.250	0.166
Copper	mg/kg dw	11.30	6.27	3.53	5.13	2.64	5.42	6.50	8.54	7.89	13.90	5.01	6.72
Iron	mg/kg dw	182	105	74	185	35	52	217	29	104	1,310	53	130
Lead	mg/kg dw	0.243	0.106	0.074	0.239	0.043	0.039	0.255	<0.0207	0.118	0.602	<0.0199	0.059
Magnesium	mg/kg dw	1,140	2,360	622	1,300	1,210	711	1,490	1,230	1,120	1,010	2,560	1,250
Manganese	mg/kg dw	204	275	1,180	151	78	635	112	225	1,350	347	256	1,500
Mercury	mg/kg dw	0.035	0.013	0.011	0.067	0.009	0.012	0.044	<0.0104	0.034	0.068	0.011	0.014
Molybdenum	mg/kg dw	1.960	2.520	6.610	3.780	0.777	6.120	0.889	0.437	1.840	4.480	2.090	10.500
Nickel	mg/kg dw	0.586	1.510	0.260	0.326	0.173	0.135	0.660	1.360	1.390	1.640	1.100	0.510
Phosphorus	mg/kg dw	916	1,380	1,020	1,030	597	1,090	956	1,380	1,170	1,050	1,120	801
Potassium	mg/kg dw	3,360	6,170	6,970	4,190	5,520	10,700	5,010	4,500	6,810	4,180	6,530	7,630
Selenium	mg/kg dw	<0.102	<0.098	<0.1	<0.099	<0.066	<0.092	<0.101	<0.104	<0.108	0.175	<0.099	<0.098
Silver	mg/kg dw	0.752	<0.049	<0.05	<0.049	<0.033	<0.046	<0.051	<0.052	<0.054	0.252	<0.05	<0.049
Sodium	mg/kg dw	37.7	21.8	21.8	35.7	15.7	40.0	46.6	20.4	33.1	54.8	24.7	45.3
Strontium	mg/kg dw	23.6	76.0	18.8	45.2	29.5	22.1	30.0	42.1	23.9	48.0	54.6	22.3
Thallium	mg/kg dw	0.0112	<0.0049	0.0107	0.0054	<0.0033	<0.0046	0.0053	<0.0052	0.0059	0.0082	<0.005	0.0083
Tin	mg/kg dw	<0.102	<0.098	<0.1	<0.099	<0.066	<0.092	<0.101	<0.104	<0.108	<0.129	<0.099	<0.098
Titanium	mg/kg dw	3.68	1.93	1.34	4.62	0.76	1.00	5.77	<0.259	2.33	14.70	0.68	2.30
Uranium	mg/kg dw	0.0066	<0.0049	<0.005	0.0062	<0.0033	<0.0046	0.0066	<0.0052	<0.0054	0.0685	<0.005	<0.0049
Vanadium	mg/kg dw	0.422	0.126	<0.1	0.355	<0.066	<0.092	0.396	<0.104	0.136	1.630	<0.099	0.157
Zinc	mg/kg dw	32.4	181.0	36.0	60.4	61.0	31.5	54.1	127.0	64.0	39.5	97.4	43.1

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.7: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess South Study Area 1 (KS1) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling											
		KS1A-LICHEN	KS1A-RED WILLOW	KS1A-SEDGE	KS1B-LICHEN	KS1B-RED WILLOW	KS1B-SEDGE	KS1C-LICHEN	KS1C-RED WILLOW	KS1C-SEDGE	KS1-LICHEN COMP	KS1-RED WILLOW COMP	KS1-SEDGE COMP
		25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22	25-Sep-22
Dry Weight	%	12.3	28.3	21.2	13.3	28.3	23.0	13.1	32.1	18.4	13.3	24.7	20.8
Aluminum	mg/kg dw	220	94	39	118	35	28	118	30	48	78	23	36
Antimony	mg/kg dw	0.0220	0.0250	0.0140	0.0168	0.0200	0.0226	0.0234	0.0107	0.0229	<0.015	0.0087	0.0236
Arsenic	mg/kg dw	0.1000	0.0554	<0.0236	0.0462	0.0386	<0.0248	0.0490	<0.0239	<0.0287	<0.0375	<0.0203	<0.0257
Barium	mg/kg dw	31.7	18.5	17.3	25.3	18.0	24.8	16.2	15.0	25.7	13.2	27.7	20.2
Beryllium	mg/kg dw	<0.0094	<0.0101	<0.0094	<0.0151	<0.0101	<0.0099	<0.0152	<0.0096	<0.0115	<0.015	<0.0081	<0.0103
Bismuth	mg/kg dw	<0.094	<0.101	<0.094	<0.151	<0.101	<0.099	<0.152	<0.096	<0.115	<0.15	<0.081	<0.103
Boron	mg/kg dw	4.79	11.50	5.85	4.51	24.00	5.14	3.27	20.10	4.07	2.57	15.60	3.70
Cadmium	mg/kg dw	3.880	3.810	0.477	1.180	2.690	1.430	0.266	6.270	0.424	0.482	3.400	0.347
Calcium	mg/kg dw	12,600	14,600	5,220	10,900	11,800	4,340	6,590	10,300	4,480	6,180	19,500	4,330
Chromium	mg/kg dw	0.545	0.349	1.170	0.307	0.402	1.150	0.298	0.089	0.646	0.205	0.125	0.487
Cobalt	mg/kg dw	1.230	4.110	0.429	0.471	1.850	0.386	0.208	1.180	0.234	0.341	7.340	0.347
Copper	mg/kg dw	9.39	5.80	11.90	5.83	8.26	9.74	3.87	5.30	5.79	3.46	7.41	7.96
Iron	mg/kg dw	360	211	107	177	107	88	151	63	94	106	64	87
Lead	mg/kg dw	0.407	0.181	0.093	0.182	0.109	0.101	0.175	0.070	0.098	0.137	0.041	0.071
Magnesium	mg/kg dw	1,210	2,080	956	1,410	1,820	711	928	1,610	556	906	2,590	635
Manganese	mg/kg dw	132	67	395	235	125	1,060	60	134	625	130	117	530
Mercury	mg/kg dw	0.033	0.012	0.012	0.044	<0.0101	<0.0099	0.028	<0.0096	0.016	0.035	0.012	0.012
Molybdenum	mg/kg dw	0.724	0.769	2.800	0.800	0.494	1.100	0.716	0.431	4.060	0.549	1.000	3.810
Nickel	mg/kg dw	0.872	1.310	1.510	0.540	1.320	0.745	0.336	0.439	0.524	0.342	1.830	0.889
Phosphorus	mg/kg dw	890	1,200	872	1,260	1,420	921	796	952	904	944	1,490	745
Potassium	mg/kg dw	3,630	5,680	10,900	6,580	9,940	13,900	4,910	4,990	7,280	3,470	8,180	10,800
Selenium	mg/kg dw	0.117	0.131	<0.094	<0.151	<0.101	<0.099	<0.152	<0.096	<0.115	<0.15	0.157	<0.103
Silver	mg/kg dw	0.115	<0.05	<0.047	<0.076	<0.05	<0.05	<0.076	<0.048	<0.057	<0.075	<0.041	0.336
Sodium	mg/kg dw	16.9	10.6	14.5	<15.1	<10.1	32.3	<15.2	10.4	42.6	<15	<8.1	15.3
Strontium	mg/kg dw	31.3	39.4	14.0	28.5	32.5	10.3	19.8	35.3	12.3	16.0	53.8	10.7
Thallium	mg/kg dw	<0.0047	<0.005	<0.0047	<0.0076	<0.005	<0.005	<0.0076	<0.0048	<0.0057	<0.0075	<0.0041	<0.0051
Tin	mg/kg dw	0.120	<0.101	0.323	<0.151	0.120	0.192	<0.152	<0.096	<0.115	<0.15	0.095	<0.103
Titanium	mg/kg dw	9.62	4.61	1.72	4.73	1.82	1.58	4.29	1.50	2.04	2.64	1.06	2.16
Uranium	mg/kg dw	0.0129	0.0061	<0.0047	0.0106	<0.005	<0.005	0.0524	0.0049	<0.0057	<0.0075	<0.0041	<0.0051
Vanadium	mg/kg dw	0.555	0.231	<0.094	0.266	<0.101	<0.099	0.264	<0.096	<0.115	<0.15	<0.081	<0.103
Zinc	mg/kg dw	70.5	156.0	62.0	46.4	113.0	41.4	20.6	179.0	43.4	31.4	173.0	60.8

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.6: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess Underground Study Area 3 (KUG3) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling							
		KUG3A-LICHEN	KUG3A-SEDGE	KUG3B-LICHEN	KUG3B-SEDGE	KUG3C-LICHEN	KUG3C-SEDGE	KUG3-LICHEN COMP	KUG3-SEDGE COMP
		23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22	23-Sep-22
Dry Weight	%	32.0	34.5	36.0	41.6	37.6	39.5	37.3	43.9
Aluminum	mg/kg dw	2,280	1,120	1,900	312	1,010	50	2,380	194
Antimony	mg/kg dw	0.1090	0.0425	0.1150	0.0183	0.0657	0.0102	0.1450	0.0109
Arsenic	mg/kg dw	1.0800	0.5350	1.4100	0.2530	0.5240	0.0328	1.5700	0.1190
Barium	mg/kg dw	51.8	53.1	33.4	25.0	89.4	56.4	36.2	34.3
Beryllium	mg/kg dw	0.0363	0.0207	0.0389	<0.0096	0.0501	<0.0101	0.0418	<0.0091
Bismuth	mg/kg dw	0.164	<0.116	0.201	<0.096	<0.106	<0.101	0.193	<0.091
Boron	mg/kg dw	1.16	2.09	<1.11	2.29	<1.06	3.18	<1.07	1.81
Cadmium	mg/kg dw	0.452	0.198	0.533	0.227	0.389	0.238	0.183	0.256
Calcium	mg/kg dw	2,470	3,260	2,040	2,450	3,410	3,680	1,020	2,140
Chromium	mg/kg dw	1.800	1.500	2.820	0.597	0.924	0.145	2.270	1.350
Cobalt	mg/kg dw	3.420	1.550	2.710	0.875	0.898	0.077	3.110	1.290
Copper	mg/kg dw	10.50	5.33	11.30	2.83	6.01	2.32	12.20	12.50
Iron	mg/kg dw	2,300	1,190	3,340	546	1,570	70	3,540	348
Lead	mg/kg dw	2.830	0.994	2.950	0.697	2.340	0.096	4.220	0.593
Magnesium	mg/kg dw	1,040	807	991	621	625	633	702	496
Manganese	mg/kg dw	284	765	150	774	245	846	272	642
Mercury	mg/kg dw	0.059	0.020	0.046	0.022	0.050	0.016	0.038	0.024
Molybdenum	mg/kg dw	0.256	0.095	0.256	0.052	0.175	<0.051	0.275	0.059
Nickel	mg/kg dw	1.830	2.180	2.070	1.720	1.030	0.653	1.930	1.830
Phosphorus	mg/kg dw	591	595	457	470	705	796	349	559
Potassium	mg/kg dw	1,310	2,580	854	4,420	1,780	6,890	599	5,210
Selenium	mg/kg dw	<0.099	<0.116	0.150	<0.096	<0.106	<0.101	<0.107	<0.091
Silver	mg/kg dw	0.076	<0.058	0.133	<0.048	0.079	<0.051	0.121	<0.046
Sodium	mg/kg dw	16.0	<11.6	26.5	<9.6	11.7	<10.1	<10.7	<9.1
Strontium	mg/kg dw	18.3	23.6	16.4	17.0	32.9	32.5	10.6	16.8
Thallium	mg/kg dw	0.0097	0.0185	0.0098	0.0161	0.0070	0.0062	0.0148	0.0144
Tin	mg/kg dw	<0.099	<0.116	<0.111	<0.096	<0.106	<0.101	<0.107	0.416
Titanium	mg/kg dw	74.90	47.10	118.00	15.90	60.20	2.27	122.00	10.20
Uranium	mg/kg dw	0.0221	0.0147	0.0292	<0.0048	0.0178	<0.0051	0.0317	<0.0046
Vanadium	mg/kg dw	4.300	2.360	5.990	0.988	2.900	<0.101	6.780	0.520
Zinc	mg/kg dw	46.2	35.9	41.6	62.8	43.7	35.3	26.2	42.4

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

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Appendix Table E.5: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess Underground Study Area 2 (KUG2) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling			
		KUG2B Reindeer Lichen	KUG2C Fireweed	KUG2C Reindeer Lichen	KUG2D Reindeer Lichen
		12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22
Dry Weight	%	67.8	22.7	67.0	62.4
Aluminum	mg/kg dw	1,120	1,640	756	979
Antimony	mg/kg dw	0.0597	<0.0088	0.0472	0.1570
Arsenic	mg/kg dw	0.7030	0.0870	0.7360	0.7100
Barium	mg/kg dw	22.6	50.1	10.0	36.8
Beryllium	mg/kg dw	0.0142	0.1610	0.0133	0.0158
Bismuth	mg/kg dw	0.146	<0.088	<0.101	0.221
Boron	mg/kg dw	<0.97	10.20	<1.01	<1.01
Cadmium	mg/kg dw	0.066	5.050	1.600	0.092
Calcium	mg/kg dw	1,220	57,700	5,250	858
Chromium	mg/kg dw	1.410	0.047	0.739	1.370
Cobalt	mg/kg dw	0.248	13.800	0.444	0.213
Copper	mg/kg dw	5.09	91.50	5.74	11.30
Iron	mg/kg dw	2,450	216	1,220	1,110
Lead	mg/kg dw	1.520	2.870	1.960	6.220
Magnesium	mg/kg dw	724	4,600	571	722
Manganese	mg/kg dw	55	1,170	106	42
Mercury	mg/kg dw	0.045	0.015	0.029	0.032
Molybdenum	mg/kg dw	1.170	0.166	0.151	0.751
Nickel	mg/kg dw	0.755	3.000	0.641	0.442
Phosphorus	mg/kg dw	632	2,270	548	483
Potassium	mg/kg dw	1,360	13,300	1,660	1,300
Selenium	mg/kg dw	0.205	<0.088	0.156	0.362
Silver	mg/kg dw	0.078	<0.044	0.069	0.248
Sodium	mg/kg dw	27.6	56.8	21.8	40.1
Strontium	mg/kg dw	10.9	96.3	10.8	7.9
Thallium	mg/kg dw	0.0077	<0.0044	0.0077	0.0116
Tin	mg/kg dw	<0.097	<0.088	<0.101	<0.101
Titanium	mg/kg dw	28.40	2.20	18.80	26.60
Uranium	mg/kg dw	0.0176	<0.0044	0.0100	0.0216
Vanadium	mg/kg dw	3.800	0.180	1.960	2.890
Zinc	mg/kg dw	20.8	405.0	40.5	19.3

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.4: Dry Weight and Metal Concentrations of Vegetation Sampled at Kemess Underground Study Area 1 (KUG1) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling								
		KUG1A Folliose Lichen	KUG1A Sedge	KUG1B Folliose Lichen	KUG1C Folliose Lichen	KUG1C Sedge	KUG1D Folliose Lichen	KUG1E Folliose Lichen	KUG1 Folliose Comp	KUG1 Sedge Comp
		12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22	12-Sep-22
Dry Weight	%	24.0	36.7	63.2	54.8	39.0	60.5	62.3	56.0	34.2
Aluminum	mg/kg dw	132	2,060	283	827	436	389	583	806	467
Antimony	mg/kg dw	0.0119	0.0589	0.0199	0.0258	0.0116	0.0247	0.0319	0.0574	0.0135
Arsenic	mg/kg dw	0.0591	0.8510	0.1150	0.1730	0.0650	0.2380	0.1840	0.2770	0.0615
Barium	mg/kg dw	18.0	40.7	11.1	36.2	29.8	20.1	57.8	37.7	20.6
Beryllium	mg/kg dw	<0.0084	0.0618	<0.0103	0.0176	0.0169	0.0114	0.0163	0.0198	0.0136
Bismuth	mg/kg dw	<0.084	0.118	<0.103	<0.103	<0.102	<0.102	<0.099	<0.097	<0.117
Boron	mg/kg dw	1.03	3.70	<1.03	<1.03	2.80	<1.02	<0.99	<0.97	2.92
Cadmium	mg/kg dw	0.521	2.600	0.064	0.073	0.053	0.098	0.084	0.080	0.204
Calcium	mg/kg dw	2,680	9,210	744	2,030	2,500	896	1,140	1,670	3,510
Chromium	mg/kg dw	0.155	4.440	0.221	0.374	1.070	0.470	0.321	0.503	1.410
Cobalt	mg/kg dw	0.141	8.020	0.200	0.217	0.090	0.313	0.911	0.325	0.435
Copper	mg/kg dw	2.96	38.70	5.04	7.42	8.55	6.19	13.00	8.76	9.67
Iron	mg/kg dw	91	3,350	321	688	586	604	559	953	601
Lead	mg/kg dw	0.184	2.090	0.426	0.626	0.202	0.846	1.110	1.100	0.171
Magnesium	mg/kg dw	651	1,420	474	754	840	599	617	625	817
Manganese	mg/kg dw	301	305	21	47	175	47	33	42	410
Mercury	mg/kg dw	0.107	0.020	0.073	0.071	0.017	0.064	0.073	0.075	0.013
Molybdenum	mg/kg dw	0.088	2.460	0.456	1.010	1.410	1.020	1.530	1.200	3.160
Nickel	mg/kg dw	0.418	3.910	0.408	0.567	2.140	0.648	1.220	0.748	1.720
Phosphorus	mg/kg dw	1,620	1,180	1,030	1,160	924	1,120	1,320	1,120	1,240
Potassium	mg/kg dw	6,880	13,900	6,130	5,860	11,700	6,300	5,900	4,950	18,600
Selenium	mg/kg dw	<0.084	0.288	<0.103	<0.103	<0.102	0.117	0.254	0.135	<0.117
Silver	mg/kg dw	<0.042	0.270	<0.051	0.070	<0.051	<0.051	0.056	0.060	0.093
Sodium	mg/kg dw	23.8	22.3	17.5	20.9	53.4	17.1	17.9	21.2	12.0
Strontium	mg/kg dw	8.5	23.7	5.7	18.2	25.7	6.1	10.0	15.8	32.3
Thallium	mg/kg dw	<0.0042	0.0189	0.0086	0.0165	0.0055	0.0110	0.0120	0.0153	0.0070
Tin	mg/kg dw	<0.084	<0.109	<0.103	<0.103	<0.102	<0.102	<0.099	<0.097	<0.117
Titanium	mg/kg dw	2.20	38.70	7.87	15.30	13.10	11.50	7.73	16.60	10.30
Uranium	mg/kg dw	<0.0042	0.0625	0.0072	0.0112	0.0082	0.0088	0.0120	0.0172	0.0091
Vanadium	mg/kg dw	0.140	4.900	0.600	1.280	1.100	1.070	0.780	1.640	1.070
Zinc	mg/kg dw	52.8	119.0	25.8	31.3	42.6	48.6	38.0	33.0	36.5

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

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Appendix Table E.3: Dry Weight and Metal Concentrations of Vegetation Sampled at Reference Site 3 (REF3) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling															
		REF3A Fireweed	REF3A Folliose Lichen	REF3A Reindeer Lichen	REF3A Sedge	REF3B Fireweed	REF3B Folliose Lichen	REF3B Reindeer Lichen	REF3B Sedge	REF3C Folliose Lichen	REF3C Reindeer Lichen	REF3D Folliose Lichen	REF3D Red Feather Moss	REF3D Reindeer Lichen	REF3E Folliose Lichen	REF3E Reindeer Lichen	REF3 Lichen Comp
		9-Sep-22	9-Sep-22	9-Sep-22	9-Sep-22	9-Sep-22	9-Sep-22	9-Sep-22	9-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22
Dry Weight	%	22.6	28.3	29.4	34.5	28.3	23.7	37.8	38.1	29.2	40.3	35.9	23.3	41.3	32.8	38.4	36.9
Aluminum	mg/kg dw	26	341	265	54	106	138	914	42	216	139	139	476	183	95	146	170
Antimony	mg/kg dw	<0.0088	0.0223	0.0214	<0.0116	<0.0102	0.0141	0.0323	0.0108	0.0142	0.0150	0.0166	0.0204	0.0151	0.0147	0.0122	0.0269
Arsenic	mg/kg dw	<0.022	0.1030	0.0861	<0.029	<0.0255	0.0676	0.1790	<0.0263	0.0725	0.0594	0.0686	0.0866	0.0538	0.0591	0.0792	0.0725
Barium	mg/kg dw	10.2	29.9	22.9	31.4	68.4	24.6	60.1	19.0	37.0	18.3	28.2	153.0	38.4	21.6	19.7	30.0
Beryllium	mg/kg dw	<0.0088	0.0128	<0.0099	<0.0116	<0.0102	<0.0084	0.0147	<0.0105	<0.01	<0.0099	<0.0111	0.0123	<0.0097	<0.0099	<0.0104	<0.0108
Bismuth	mg/kg dw	<0.088	<0.1	<0.099	<0.116	<0.102	<0.084	<0.106	<0.105	<0.1	<0.099	<0.111	<0.086	<0.097	<0.099	<0.104	<0.108
Boron	mg/kg dw	54.50	1.36	<0.99	8.25	8.22	1.32	1.19	11.50	1.27	<0.99	<1.11	1.99	<0.97	1.81	1.17	1.31
Cadmium	mg/kg dw	0.012	0.098	0.051	0.042	0.015	0.075	0.094	0.118	0.066	0.039	0.164	0.270	0.108	0.102	0.048	0.076
Calcium	mg/kg dw	14,900	1,950	1,780	5,990	11,000	2,150	2,390	8,940	3,600	1,940	1,680	9,530	3,060	1,770	2,140	2,460
Chromium	mg/kg dw	0.129	0.384	0.295	0.410	0.322	0.213	1.100	0.543	0.386	0.128	0.169	0.406	0.162	0.208	0.149	0.216
Cobalt	mg/kg dw	0.029	0.335	0.188	0.037	0.044	0.133	0.386	0.052	0.207	0.103	0.172	0.449	0.170	0.119	0.083	0.121
Copper	mg/kg dw	5.15	5.75	4.07	3.67	4.67	3.97	5.58	5.64	4.15	2.13	4.04	5.61	2.71	4.09	2.26	3.61
Iron	mg/kg dw	60	296	241	75	67	142	588	79	174	137	129	308	136	99	139	165
Lead	mg/kg dw	0.042	0.453	0.314	0.025	0.049	0.238	0.888	0.055	0.246	0.165	0.187	0.345	0.237	0.159	0.175	0.221
Magnesium	mg/kg dw	3,280	558	416	952	3,340	623	544	985	621	380	604	789	462	586	320	473
Manganese	mg/kg dw	110	422	452	117	145	371	380	61	796	363	504	2,290	626	494	692	514
Mercury	mg/kg dw	0.023	0.106	0.053	<0.0116	0.019	0.085	0.060	0.014	0.097	0.057	0.108	0.083	0.068	0.089	0.059	0.087
Molybdenum	mg/kg dw	10.500	0.150	0.126	1.850	0.437	0.150	0.526	3.150	0.160	0.118	0.246	0.309	0.149	0.302	0.143	0.277
Nickel	mg/kg dw	0.106	0.977	0.642	0.291	0.633	0.466	0.910	0.137	0.612	0.294	0.388	0.770	0.366	0.309	0.234	0.347
Phosphorus	mg/kg dw	2,010	1,530	703	972	1,150	1,220	728	688	1,680	677	2,170	1,330	1,020	1,560	708	1,130
Potassium	mg/kg dw	8,800	6,180	1,750	15,500	5,680	5,730	1,590	10,700	7,150	1,770	8,880	2,890	2,300	8,820	1,820	4,450
Selenium	mg/kg dw	<0.088	<0.1	<0.099	<0.116	<0.102	<0.084	<0.106	0.228	<0.1	<0.099	<0.111	<0.086	<0.097	<0.099	<0.104	<0.108
Silver	mg/kg dw	<0.044	<0.05	<0.049	<0.058	<0.051	<0.042	<0.053	<0.053	<0.05	<0.05	<0.056	<0.043	<0.048	<0.049	<0.052	<0.054
Sodium	mg/kg dw	43.2	21.3	19.9	28.6	30.1	20.5	23.1	20.9	31.3	14.4	23.3	24.0	21.8	19.1	19.6	21.1
Strontium	mg/kg dw	53.4	6.6	4.6	38.7	84.7	6.8	15.7	45.6	8.0	5.0	6.5	24.2	9.6	5.1	5.2	7.6
Thallium	mg/kg dw	<0.0044	0.0403	0.0186	<0.0058	<0.0051	0.0235	0.0143	<0.0053	0.0317	0.0106	0.0271	0.1310	0.0283	0.0171	0.0131	0.0179
Tin	mg/kg dw	<0.088	<0.1	<0.099	<0.116	<0.102	<0.084	<0.106	<0.105	<0.1	<0.099	<0.111	<0.086	<0.097	<0.099	<0.104	<0.108
Titanium	mg/kg dw	1.41	7.34	6.75	1.84	2.62	4.09	27.40	1.45	5.39	4.39	4.09	9.97	4.34	3.01	4.53	5.30
Uranium	mg/kg dw	<0.0044	0.0093	0.0064	<0.0058	<0.0051	0.0043	0.0199	0.0721	<0.005	<0.005	<0.0056	0.0221	<0.0048	<0.0049	<0.0052	0.0056
Vanadium	mg/kg dw	<0.088	0.539	0.413	<0.116	0.110	0.275	1.600	0.184	0.351	0.248	0.255	0.717	0.257	0.199	0.270	0.327
Zinc	mg/kg dw	19.0	34.2	15.8	20.2	22.4	25.3	20.7	28.4	31.2	15.6	41.0	50.8	25.5	36.1	18.0	26.6

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.2: Dry Weight and Metal Concentrations of Vegetation Sampled at Reference Site 2 (REF2) in 2022

Parameter	Units	Replicate, Vegetation Type, and Date of Sampling													
		REF2A Folliose Lichen	REF2A Reindeer Lichen	REF2B Folliose Lichen	REF2B Reindeer Lichen	REF2C Fireweed	REF2C Reindeer Lichen	REF2C Sedge	REF2D Fireweed	REF2D Folliose Lichen	REF2D Reindeer Lichen	REF2E Fireweed	REF2E Reindeer Lichen	REF2 Fireweed Comp	REF2 Lichen Comp
		11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22	11-Sep-22
Dry Weight	%	42.0	63.7	33.3	41.9	24.1	38.1	29.2	21.7	49.2	53.6	27.2	50.2	21.9	48.8
Aluminum	mg/kg dw	376	174	888	848	453	1,250	32	54	889	1,920	378	3,220	24	831
Antimony	mg/kg dw	0.0284	0.0126	0.0254	0.0408	<0.0083	0.0392	<0.0103	<0.0092	0.0186	0.0466	<0.0099	0.0496	<0.0091	0.0357
Arsenic	mg/kg dw	0.1170	0.0599	0.2520	0.2180	<0.0413	0.3010	<0.0257	<0.023	0.1550	0.5000	0.1470	0.8350	<0.0227	0.1960
Barium	mg/kg dw	25.8	9.5	31.3	30.7	29.0	53.6	16.0	25.3	32.5	46.3	13.8	28.1	19.5	27.2
Beryllium	mg/kg dw	0.0129	<0.0099	0.0255	0.0231	0.2710	0.0468	<0.0103	<0.0092	0.0151	0.0485	<0.0099	0.0868	0.0107	0.0187
Bismuth	mg/kg dw	<0.095	<0.099	<0.097	<0.095	<0.083	<0.105	<0.103	<0.092	<0.102	<0.097	<0.099	<0.102	<0.091	<0.082
Boron	mg/kg dw	0.96	<0.99	<0.97	<0.95	18.50	<1.05	4.77	5.52	<1.02	1.13	8.83	1.08	17.30	<0.82
Cadmium	mg/kg dw	0.064	0.032	0.084	0.050	0.030	0.127	0.215	0.037	0.097	0.362	0.450	0.841	0.026	0.222
Calcium	mg/kg dw	1,470	640	1,840	1,500	27,300	2,710	7,420	24,400	1,700	4,090	15,800	5,670	22,700	2,120
Chromium	mg/kg dw	0.578	0.142	0.793	0.740	1.440	2.460	0.353	0.600	0.733	5.310	1.710	10.100	0.196	1.270
Cobalt	mg/kg dw	0.241	0.072	0.455	0.264	0.267	1.100	0.061	0.093	0.388	1.550	0.715	2.310	0.029	0.526
Copper	mg/kg dw	4.52	1.27	7.43	3.65	16.80	5.53	4.59	12.10	8.25	7.28	6.02	56.40	5.01	4.34
Iron	mg/kg dw	235	113	581	545	269	1,520	66	89	404	2,110	734	3,050	46	663
Lead	mg/kg dw	0.407	0.209	0.710	0.857	0.142	1.010	0.029	0.028	0.527	1.580	0.211	2.480	0.023	0.790
Magnesium	mg/kg dw	498	239	606	376	3,400	798	1,030	5,800	681	1,300	3,920	1,660	4,290	539
Manganese	mg/kg dw	30	20	80	68	149	116	139	122	61	160	134	130	135	54
Mercury	mg/kg dw	0.074	0.023	0.093	0.044	0.019	0.071	0.011	0.025	0.089	0.060	0.018	0.057	0.026	0.052
Molybdenum	mg/kg dw	0.143	<0.05	0.303	0.307	0.500	0.296	1.790	2.000	0.246	0.724	0.881	0.721	0.731	0.175
Nickel	mg/kg dw	0.649	0.209	1.490	0.889	1.140	2.670	0.422	2.430	1.140	4.550	2.670	7.490	0.435	1.310
Phosphorus	mg/kg dw	908	408	1,090	525	1,450	597	1,020	1,500	1,200	796	857	656	1,110	646
Potassium	mg/kg dw	4,170	1,010	5,380	1,230	13,200	1,380	16,700	12,000	5,400	1,370	8,310	1,390	9,840	2,170
Selenium	mg/kg dw	<0.095	<0.099	<0.097	<0.095	<0.083	<0.105	<0.103	<0.092	<0.102	<0.097	<0.099	0.104	<0.091	<0.082
Silver	mg/kg dw	<0.048	<0.05	0.056	<0.048	<0.041	<0.053	<0.051	<0.046	<0.051	0.057	<0.05	0.061	<0.045	<0.041
Sodium	mg/kg dw	18.2	15.7	21.5	23.1	86.1	24.3	37.7	41.6	19.9	26.1	42.6	24.0	92.8	25.3
Strontium	mg/kg dw	10.0	4.0	8.1	8.5	70.4	16.0	24.5	38.9	8.2	14.7	20.4	19.0	52.2	10.7
Thallium	mg/kg dw	0.0089	<0.005	0.0130	0.0096	<0.0041	0.0071	<0.0051	0.0047	0.0098	0.0117	<0.005	0.0099	<0.0045	0.0059
Tin	mg/kg dw	<0.095	<0.099	<0.097	<0.095	0.647	<0.105	<0.103	0.233	0.155	<0.097	<0.099	2.000	<0.091	<0.082
Titanium	mg/kg dw	9.89	5.43	22.00	23.40	5.17	55.20	1.35	0.60	20.40	93.60	21.10	138.00	0.52	32.10
Uranium	mg/kg dw	0.0067	<0.005	0.0125	0.0110	0.0057	0.0242	<0.0051	<0.0046	0.0116	0.0447	0.0112	0.0748	<0.0045	0.0134
Vanadium	mg/kg dw	0.490	0.228	1.080	1.050	0.555	3.720	<0.103	<0.092	0.964	4.860	1.000	6.500	<0.091	1.580
Zinc	mg/kg dw	24.3	8.3	40.5	14.2	30.7	26.9	36.3	38.3	40.4	30.7	42.1	45.6	21.4	24.0

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

Appendix Table E.1: Dry Weight and Metal Concentrations of Vegetation Sampled at Reference Site 1 (REF1) in 2022

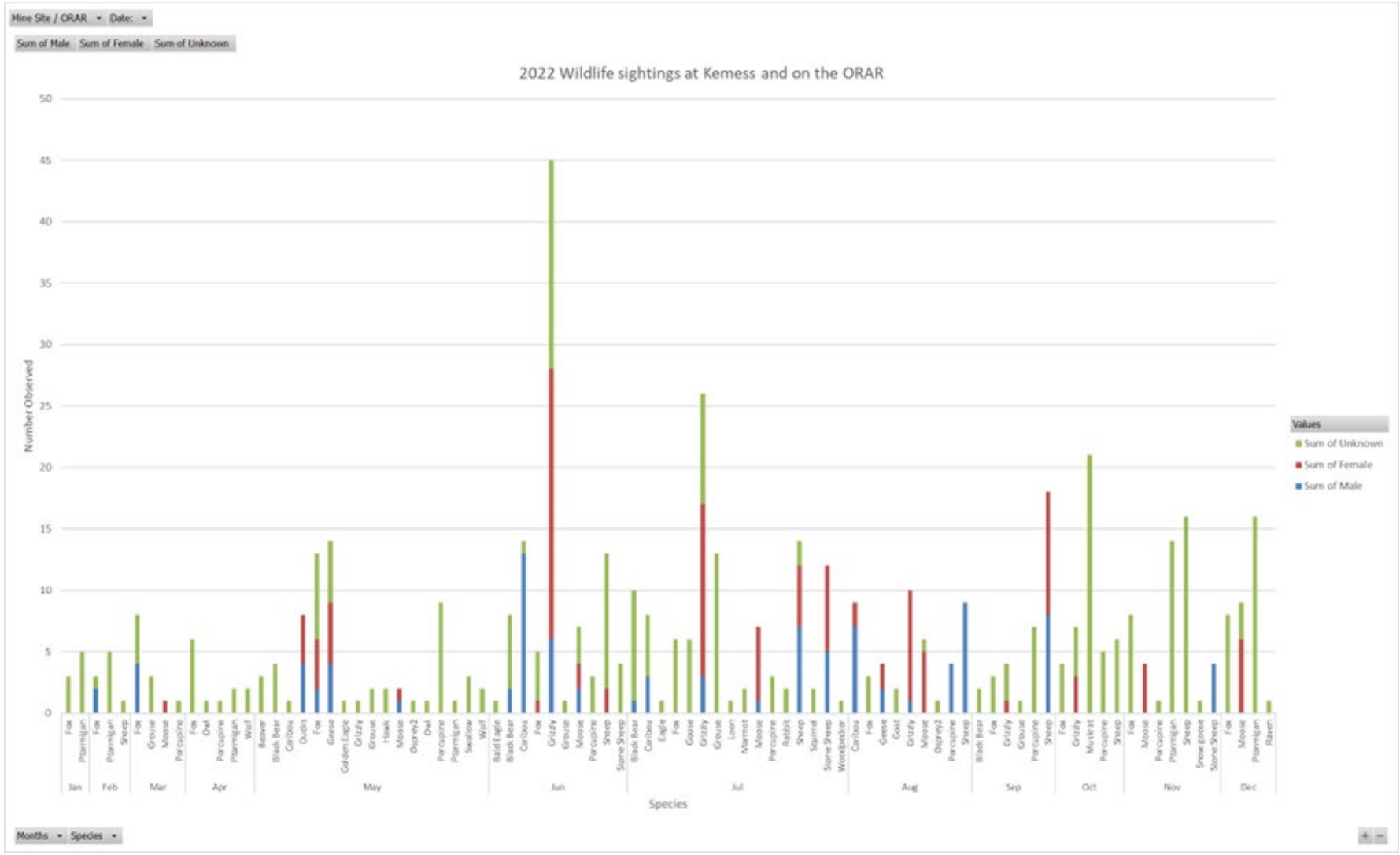
Parameter	Units	Replicate, Vegetation Type, and Date of Sampling													
		REF1A Berries	REF1A Fireweed	REF1A Reindeer Lichen	REF1B Folliose Lichen	REF1B Fireweed	REF1B Reindeer Lichen	REF1C Berries	REF1C Folliose Lichen	REF1C Reindeer Lichen	REF1D Folliose Lichen	REF1D Reindeer Lichen	REF1E Berries	REF1E Reindeer Lichen	REF1 Lichen Comp
		10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22	10-Sep-22
Dry Weight	%	25.7	20.5	31.0	29.4	21.5	31.7	10.8	30.0	32.6	22.5	39.5	11.1	41.6	31.9
Aluminum	mg/kg dw	33	52	111	168	75	124	44	234	309	132	213	28	170	220
Antimony	mg/kg dw	<0.0077	0.0099	0.0114	0.0117	<0.0093	0.0142	<0.0101	0.0169	0.0143	0.0095	0.0133	<0.01	0.0099	0.0130
Arsenic	mg/kg dw	<0.0194	0.0445	0.0327	0.0498	0.0516	0.0868	<0.0253	0.0676	0.0600	0.0377	0.0362	<0.025	0.0328	0.0714
Barium	mg/kg dw	11.6	35.7	10.8	18.7	56.4	9.4	5.8	21.5	8.8	14.1	8.1	5.8	7.8	24.6
Beryllium	mg/kg dw	<0.0077	<0.0096	<0.0101	<0.0101	<0.0093	<0.0101	<0.0101	<0.0108	<0.0102	<0.0089	<0.0101	<0.01	<0.0096	<0.0099
Bismuth	mg/kg dw	<0.077	<0.096	<0.101	<0.101	<0.093	<0.101	<0.101	<0.108	<0.102	<0.089	<0.101	<0.1	<0.096	<0.099
Boron	mg/kg dw	2.17	8.27	<1.01	<1.01	7.62	<1.01	2.18	<1.08	<1.02	0.92	<1.01	3.64	<0.96	<0.99
Cadmium	mg/kg dw	<0.0077	0.026	0.129	0.124	0.084	0.255	0.014	0.119	0.070	0.105	0.050	0.033	0.111	0.159
Calcium	mg/kg dw	841	13,800	1,510	1,770	12,500	1,370	917	2,510	1,120	2,070	824	908	1,450	2,640
Chromium	mg/kg dw	<0.039	0.322	0.119	0.244	0.142	0.357	<0.051	0.245	0.221	0.128	0.149	<0.05	0.120	0.176
Cobalt	mg/kg dw	<0.0155	0.023	0.081	0.116	0.046	0.076	<0.0202	0.157	0.090	0.098	0.078	0.032	0.097	0.140
Copper	mg/kg dw	1.71	7.35	1.34	2.95	6.12	1.41	5.25	3.56	1.77	3.43	1.21	4.93	1.50	2.72
Iron	mg/kg dw	11	87	64	105	91	141	23	132	127	77	80	27	61	121
Lead	mg/kg dw	<0.0155	0.056	0.119	0.217	0.067	0.147	<0.0202	0.223	0.156	0.144	0.131	<0.02	0.093	0.243
Magnesium	mg/kg dw	345	2,670	310	546	3,530	328	499	675	225	601	207	476	353	351
Manganese	mg/kg dw	252	117	349	276	178	83	132	372	251	511	191	68	304	278
Mercury	mg/kg dw	<0.0077	0.025	0.023	0.070	0.027	0.027	0.012	0.088	0.034	0.064	0.024	0.011	0.027	0.048
Molybdenum	mg/kg dw	0.043	1.620	<0.05	0.082	0.726	0.069	0.109	0.064	0.054	<0.044	0.068	0.084	<0.048	0.065
Nickel	mg/kg dw	0.184	0.213	0.388	0.601	0.398	0.173	0.276	0.833	0.408	0.551	0.350	0.479	0.392	0.488
Phosphorus	mg/kg dw	782	2,580	535	1,300	1,720	496	982	1,410	489	1,530	506	926	651	808
Potassium	mg/kg dw	3,990	15,400	1,080	5,760	12,200	1,320	9,200	5,770	850	5,010	1,060	9,050	1,590	2,440
Selenium	mg/kg dw	<0.077	<0.096	<0.101	<0.101	<0.093	<0.101	<0.101	<0.108	<0.102	<0.089	<0.101	<0.1	<0.096	<0.099
Silver	mg/kg dw	<0.039	<0.048	<0.05	0.055	<0.046	<0.05	<0.051	0.079	0.051	<0.044	<0.051	<0.05	<0.048	<0.049
Sodium	mg/kg dw	<7.7	28.7	16.3	17.9	38.2	13.8	26.2	22.3	19.8	15.2	41.9	49.5	14.3	17.9
Strontium	mg/kg dw	1.8	40.1	3.8	5.5	49.1	4.3	1.6	7.8	4.2	8.5	3.4	1.7	3.9	8.6
Thallium	mg/kg dw	<0.0039	<0.0048	<0.005	0.0067	<0.0046	<0.005	<0.0051	<0.0054	0.0107	<0.0044	<0.0051	<0.005	0.0056	<0.0049
Tin	mg/kg dw	<0.077	<0.096	<0.101	<0.101	<0.093	<0.101	<0.101	<0.108	<0.102	<0.089	<0.101	<0.1	<0.096	<0.099
Titanium	mg/kg dw	<0.194	1.97	1.67	2.50	2.16	8.47	0.46	3.25	4.11	1.79	2.55	<0.25	1.60	4.84
Uranium	mg/kg dw	<0.0039	<0.0048	<0.005	<0.005	0.0054	0.0128	<0.0051	<0.0054	<0.0051	<0.0044	<0.0051	<0.005	<0.0048	0.0065
Vanadium	mg/kg dw	<0.077	<0.096	0.102	0.182	0.099	0.349	<0.101	0.219	0.232	0.118	0.141	<0.1	0.104	0.224
Zinc	mg/kg dw	6.7	23.3	29.3	37.5	28.0	16.0	7.5	34.2	13.6	51.6	17.1	6.9	21.9	29.7

Shading indicates parameter concentration equal to or above applicable Sediment Quality Guideline.

[a] Sediment Quality Guideline presented represents the lowest applicable value among the Canadian Environmental Quality Guidelines (CCME 2017) Soil Quality Guidelines for Agricultural Purposes, the British Columbia Contaminated Sites Regulation (CSR; BC Reg. 375/96) Numerical Soil Standards for Natural Wildlands Relating to Toxicity to Soil Invertebrates and Plants, the British Columbia CSR Numerical Soil Standards for Natural Wildlands Relating to Groundwater Flow to (Freshwater) Surface Water Used by Aquatic Life, or British Columbia CSR Generic Numerical Soil Standards to Protect Ecological Health within Natural Wildlands (BC Reg. 375/96 Schedule 3.1, Part 3). Parameters in which no Sediment Quality Guidelines available indicated by "na" (none applicable).

APPENDIX C

Wildlife Sighting at Kemess Mine and on the Omineca Resource Access Road (ORAR)


Mine Site / ORAR
Date:
Sum of Male
Sum of Female
Sum of Unknown
2022 Wildlife sightings at Kemess and on the ORAR
Number Observed
0
5
10
15
20
25
30
35
40
45
50
Values
Sum of Unknown
Sum of Female
Sum of Male
Species
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Months
Species

APPENDIX D

Accidents and Malfunctions Communication Plan

KEMESS UNDERGROUND PROJECT

AuRico Metals Inc., a subsidiary of Centerra Gold Inc.

Accidents and Malfunctions Communications Plan

Version: 2.0

Date: July 2018

AuRico Metals Inc.
1 University Ave Suite 1500
Toronto, ON
Canada M5J 2P1
T: (416) 204-1953
F: (416) 204-1954

DOCUMENT TRACKING

DATE ISSUED				Complies With:	
July 2018					
EFFECTIVE DATE		MANUAL			
				ORIGINATING DEPARTMENT	
		Doc No.:			
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July 2018	C.Gouger	J. Evans	S. Masse		

Accidents and Malfunctions Communications Plan

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS, ABBREVIATIONSAND DEFINTIONS

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

Aboriginal Groups	As defined in the BC EAO M-1701 the term used to describe Takla Lake First Nation, Tsay Keh Dene Nation and Kwadacha Nation.
AuRico	AuRico Metals Inc.
BC	British Columbia
CEAA	Canadian Environmental Assessment Agency
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CEPA 1999	*Canadian Environmental Protection Act, 1999*
Code (the)	Health, Safety and Reclamation Code for Mines in British Columbia
EA	Environmental Assessment
EAO	Environmental Assessment Office
EMC	Environmental Management Committee
FLNRO	Ministry of Forests, Lands and Natural Resource Operations (British Columbia)
FMEA	Failure Modes and Effects Analysis
IBA	Impact Benefit Agreement
Indigenous Groups	As defined by CEAA to mean Takla Lake First Nation, Tsay Keh Dene First Nation, and Kwadacha First Nation.
KUG	Kemess Underground
MEM	Ministry of Energy and Mines (British Columbia)
MoE	Ministry of Environment (British Columbia)
Project	KUG Project
TKN	Tse Keh Nay
TSF	Tailings Storage Facility

1. PURPOSE AND OBJECTIVES

The Accidents and Malfunctions Communications Plan is developed as an outcome of the Environmental Assessment process and the condition (#17) that is included with the Environmental Assessment (EA) Certificate M17-01 issued on March 15, 2017 under the British Columbia (BC) *Environmental Assessment Act* (2002) and *Canadian Environmental Assessment Act, 2012* (CEAA; 2012) Decision Statement condition 9.5 also issued on March 15, 2017.

2. PLANNING

2.1 ROLES AND RESPONSIBILITIES

AuRico Metals will be responsible for implementing this plan and initiating the communication of Accidents and Malfunctions, if any occur, in accordance with timelines that are mandated by the relevant legislation and conditions of the relevant permit. Where an Accident or Malfunction is of a minor nature and there is no reporting requirement, AuRico will report the event or events on a quarterly basis or in the case of Tsay Keh Nay at the next Environmental Management Committee (EMC) meeting. Additionally, AuRico has a responsibility to keep the BC Environmental Assessment Office (EAO), Canadian Environmental Assessment Agency (CEAA), Takla Lake, Kwadacha, Tsay Keh Dene, Gitxsan Wilp Nii Kyap First Nations, Ministry of Forests, Lands and Natural Resource Operations (FLNRO), Ministry of Energy and Mines (MEM), Ministry of Environment (MoE), and Northern Health Authority informed of changes in contact information.

The First Nations, FLNRO, MEM, MoE, and Northern Health Authority likewise have a responsibility to maintain their contact information up to date, and to respond in a timely manner with follow up questions, comments, observations, and offers of assistance.

Indigenous Groups have a responsibility to maintain an up to date register of Aboriginal Businesses that identifies to AuRico where they may have the capacity and resources to assist in the event of accidents and malfunctions for which AuRico has inadequate physical resources to deal with the event in question.

If there is a major accident or malfunction that has the potential to affect people who are on the land in the area of Kemess, Indigenous Groups will have the responsibility of notifying AuRico as to where these people are and how AuRico may communicate with them. Alternately members who are on the land may choose to notify Kemess Security of their whereabouts when they arrive in the area.

2.2 COMPLIANCE OBLIGATIONS

2.2.1 Legislation and Regulations

Some of the Accidents and Malfunctions that were evaluated in the Failure Modes and Effects Analysis as part of the Environmental Assessment process, and as part of normal best management practice, are covered by Legislation and Regulation. Specifically, many of these potential Accidents and Malfunctions are regulated under the following:

- *Health, Safety and Reclamation Code for Mines in British Columbia* (Code; BC MEM 2017);
- BC *Mines Act* (1996a);
- *Occupational Health and Safety Regulation* (BC Reg. 296/97);
- *Workers Compensation Act* (1996b);
- BC *Environmental Management Act* (2003);
- *Spill Reporting Regulation* (BC Reg. 263/90);
- *Fisheries Act* (1985a);
- *Transportation of Dangerous Goods Act* (1992);
- *Transportation of Dangerous Goods Regulations* (SOR/2001-286);
- *Canadian Environmental Protection Act, 1999* (CEPA; 1999) and *Environmental Emergency Regulations* (SOR/2003-307);
- *Hazardous Products Act* (1985c);
- *Hazardous Materials Information Review Act* (1985b);
- Controlled Products Regulations (SOR/88-66); and
- Workplace Hazardous Materials Information System Regulation (Mines) (BC Reg. 257/88).

A number of Kemess Underground (KUG) Project permit applications also require the creation of Management Plans, which cover the responses to specific material accidents and malfunctions that were evaluated as part of Failure Modes and Effects Analysis (FMEA)

These Management Plans have been created as part of the KUG Project permitting process and as part of the Environmental Management System.

2.2.2 Provincial EA Certificate

Condition #17 of the Provincial EA Certificate issued on March 15, 2017 under the BC *Environmental Assessment Act* (2002) specifically states:

> *The Holder must develop a communication plan for accidents and malfunctions. The plan must be developed in consultation with FLNRO, MEM, MoE and Aboriginal Groups.*

The plan must include at least the following:

a) The types of accidents and malfunctions requiring notification by the Holder and the timeframe of notification (including updates subsequent to the initial notification) to each Aboriginal Group community and other users of the area that could be affected;

b) Information to be included in the notifications required by bullet a), and subsequent notifications, include but are not limited to:

i) Health advisories;

ii) Remedial action being taken by the Holder; and

iii) Details of subsequent monitioring.

c) The manner by which Aboriginal Groups, communities or other users of the area must be notified by the Holder of an accident or malfunction, and of any opportunties for the Aboriginal Groups, communities and other users of the area to assist in response to the accident or malfunction; and

d) The contact information of the representatives of the Holder and the Aboriginal Groups, communities and other users of the area to which the Holder must provide notification and a plan to regularly update this information.

The Holder must provide this draft plan to FLNRO, MEM, MoE, Aboriginal Groups and EAO for review a minimum of 45 days prior to the planned commencement of Construction.

The plan and any amendments thereto, must be developed and implemented throughout Construction, Operations, Closure and Post Closure to the satisfaction of EAO.

2.2.3 Federal EA Decision Statement

Condition 2.11 of the Federal Decision Statement issued on March 15, 2017 under CEAA 2012 specifically states:

The Proponent shall publish on the Internet, or any medium which is widely publicly available […] the reports related to accidents and malfunctions referred to in conditions 9.4.3 and 9.4.4, the communication plan referred to in condition 9.5.

Condition 9.4

9.4 In the event of an accident or malfunction with the potential to cause adverse environmental effects, the Proponent shall implement the emergency response plan referred to in condition 9.3 and shall:

- *9.4.1 notify Indigenous groups, Gitxsan Wilp Nii Kyap, and relevant authorities of the accident or malfunction as soon as possible, and notify the Agency in writing;*
- *9.4.2 implement immediate measures to mitigate any adverse environmental effects associated with the accident or malfunction;*
- *9.4.3 submit a written report to the Agency no later than 30 days after the day on which the accident or malfunction took place. The written report shall include:*
    - *9.4.3.1 a description of the accident or malfunction and of its adverse environmental effects;*

- *9.4.3.2 the measures that were taken by the Proponent to mitigate the adverse environmental effects of the accident or malfunction;*
- *9.4.3.3 any views received from Indigenous groups, Gitxsan Wilp Nii Kyap, and relevant authorities with respect to the accident or malfunction, its adverse environmental effects, and measures taken by the Proponent to mitigate adverse environmental effects;*
- *9.4.3.4 a description of any residual adverse environmental effects and any modified or additional measures required by the Proponent to mitigate residual adverse environmental effects;*
- *9.4.3.5 details concerning the implementation of the emergency response plan referred to in condition 9.3; and*

- *9.4.4 submit a written report to the Agency, no later than 90 days after the day on which the accident or malfunction took place, on the changes made to avoid a subsequent occurrence of the accident or malfunction, and on the implementation of any modified or additional measures to mitigate and monitor residual adverse environmental effects and to carry out any required progressive reclamation, taking into account the information in the written report submitted pursuant to condition 9.4.3.*

Condition #9.5 of the Federal Decision Statement specifically states:

> *The Proponent shall develop and implement a communication plan in consultation with Indigenous groups (a defined term meaning Takla Lake, Tsay Keh Dene, and Kwadacha First Nations) and Gitxsan Wilp Nii Kyap. The Proponent shall develop the communication plan prior to construction and shall implement and maintain it up to date from the start of construction to the end of decommissioning. The plan shall include:*
>
> *9.5.1 the type of incidents and malfunctions requiring the Proponent to notify the respective Indigenous groups and Gitxsan Wilp Nii Kyap;*
>
> *9.5.2 the manner by which Indigenous groups and Gitxsan Wilp Nii Kyap shall be notified by the Proponent of an accident or malfunction and of any opportunities for the Indigenous groups and Gitxsan Wilp Nii Kyap to assist in the response to the accident or malfunction; and*
>
> *9.5.3 the contact information of the representatives of the Proponent that the Indigenous groups and Gitxsan Wilp Nii Kyap may contact and of the representatives of the respective Indigenous groups and Gitxsan Wilp Nii Kyap to which the Proponent provides notification.*

3. IMPLEMENTATION

3.1 TYPE OF ACCIDENTS AND MALFUNCTIONS REQUIRING NOTIFICATION AND TIMELINE OF NOTIFICATION

High Environmental Risk accidents and malfunctions – of which two were identified in the FMEA process: 1) KUG Tailings Storage Facility (TSF) East Dam failure and 2) KUG TSF East Dam or pit wall overtopping – will require notification on a timeline as per the Mine Emergency Response Plan and the Code (BC MEM 2017). AuRico will conduct a post remediation Human Health Risk Assessment for High Environmental Risks accidents and malfunctions.

Four Moderate Environmental Risks were identified in the FMEA process. These events are as follows:

1. Leak/spill of hazardous substances stored on-site;
2. Leak/spill during road, air or water transport;
3. Fires or explosions; and
4. Discharge water quality exceedance to the receiving waterbody, Attichika Creek, during construction and operations.

Low Risk Failure Modes include a broad spectrum of leaks, releases of contaminants or sediments, industrial accidents, equipment malfunctions, and geotechnical hazards. Depending of the nature of the event, these will be reported to MEM and/or MoE as per requirements of various permits such as in Incident Reports or Annual Compliance Reports. In all cases, these events will be reported internally in accordance with internal reporting procedures and reporting to Tse Keh Nay via the EMC (i.e., the TKN-AuRico committee and not the EMC of Condition #12 of the BC EA Certificate). The frequency of EMC meetings is on an as-needed basis but no less than quarterly. Gitxsan Wilp Nii Kyap will receive quarterly reports.

Updates subsequent to the initial notification to each Aboriginal Group's, Gitxsan Wilp Nii Kyap, community and other users of the area that could be affected will be on a case by case basis as determined by either the EMC or the First Nations Chief of the potentially affected community in consultation with AuRico. Updates will use best practices and include communication process to clearly and carefully relay information to mitigate and minimize mental health impacts of an environmental accident or malfunction. A variety of communication tools and methods will be used to reach the target audience, get information to the audience when they need it, for as long as they need it and can be accessed within resource limitations.

3.2 INFORMATION TO BE INCLUDED IN THE NOTIFICATION OF THE ACCIDENT AND MALFUNCTION

Information to be provided for High to Moderate environmental risk accidents and malfunctions will, as a minimum, be determined by legislation/permit conditions and/or relevant Management Plans such as, but not limited to, the Mine Emergency Response Plan and the Code (BC MEM 2017). The information will include remedial actions that have been taken and those planned actions to be undertaken, a schedule indicating the timing and nature of the actions taken, resources available and additional resources required. Health advisories will be included, as deemed necessary, in consultation with key agencies such as Northern Health and First Nations that are potentially affected. The necessity of subsequent monitoring will be determined in consultation with the AuRico-TKN EMC and the EMC (EAO condition #12); and will also be in accordance with AuRico's commitment to a strategy of Adaptive Environmental Management, an Ecosystem-based Approach, the Precautionary Principle and Sustainable Development, as defined in the Impact Benefit Agreement (IBA) with TKN.

Information on Low environmental risk accidents and malfunctions will be reported in accordance with internal procedures. For Tsay Keh Nay, reporting of low risk events will be via the EMC (i.e., the TKN-AuRico committee and not the EMC of Condition #12 of the BC EA Certificate). Gitxsan Wilp Nii Kyap will receive quarterly reports on low environmental risks accident and malfunctions. Subsequent monitoring will be in accordance with the terms of the relevant management plan unless the indigenous determines that adjustments are needed.

3.3 MANNER OF NOTIFICATION AND OPPORTUNITIES TO ASSIST

Aboriginal Group communities will initially be notified by AuRico of an accident or malfunction by telephone to the Band office in the event of a high or moderate risk event, as defined in Table 3.3-1, followed by an e-mail or fax with confirmation of receipt requested. In the event of low risk events, these will be communicted to the EMC by e-mail and information about these events will be located in a repository of information that AuRico has committed to establishing with the EMC.

Table 3.3-1. Types of Accident or Malfunction and Corresponding Timeline of Notification

Type of Accident or Malfunction	Timeline of Notification
KUG TSF East Dam Failure	Within 24 hours
KUG TSF East Dam or pit wall overtopping	Within 24 hours
Leak/spill of hazardous substances stored on site	Within 24 hours
Leak/spill during road, air or water transport	Within 24 hours
Fires or explosions	Within 24 hours
Discharge water quality exceedance to receiving waterbody	Within 24 hours

Signs posted on the Omineca Resource Access Road will encourage other users of the area to report their presence, approximate location and method of communication to Kemess security personnel so that AuRico can attempt to contact them in the event of an emergency at site.

Any opportunties for the Indigenous groups to assist in response to the accident or malfunction will be communicated to the the Tse Keh Nay designated Business Opportunities Committee members who have committed to maintaining a TKN Business Registry and to the Gitxsan Wilp Nii Kyap.

Communities and other users of the area will have the opportunity to assist in the response to the accident or malfunction if they have provided information about their potential services and their contact details to AuRico.

Per condition 2.11 of the CEAA Decision Statement, the reports related to accidents and malfunctions and this Communications Plan will be published on the Company's website, https://www.centerragold.com/operations/kemess, in the section related to the KUG Project.

3.4 CONTACT INFORMATION

First Nations

First Nation and Local Stakeholders	Contact Information
Kwadacha First Nation	250-471-2302
Prince George Office	250-563-4161
Tsay Keh Dene	250-993-2100
Prince George Office	250-562-8882
Takla Lake First Nation	250-564-9321
Prince George Office	250-996-7877
Gitxsan Wilp Nii Kyap	250-842-6780
Ron Steffey – Moose Valley Guide Outfitters	604-484-8278
Jean Tom, lead spokesperson, Trapline 0739T006	250-596-4649

AuRico Metals and Kemess Mine Site

Prince George Office	Toronto Office
AuRico Metals Inc 177 Victoria St Suite 100, Prince George, BC V2L 5R8	AuRico Metals Inc. 1 University Ave Suite 1500 Toronto, ON Canada M5J 2P1 T: (416) 204-1953 F: (416) 204-1954

Name	Title	Ext.	Direct	Mobile
Sean Masse	Project Manager	3820	778-724-4429	604-754-9671
Bruce Grau	Site Superintendent	3825	778 724-4425	NA
Gord Shepherd	Site Superintendent	3826	778 724-4426	NA
Jordan Evans	Environmental Manager	3833	778 724-2500	250-318-6348
Security Gatehouse		3802	778 724 4431	NA

3.5 REPORTING AND RECORDKEEPING

CEAA shall be notified of the accident or malfunction, as soon as possible, in writing. Within 30 days of the accident or malfunction a written report will be submitted to the Agency which includes:

- a description of the accident or malfunction and of its adverse environmental effects;
- the measures that were taken by the Proponent to mitigate the adverse environmental effects of the accident or malfunction;

- any views received from Indigenous groups, Gitxsan Wilp Nii Kyap, and relevant authorities with respect to the accident or malfunction, its adverse environmental effects, and measures taken by the Proponent to mitigate adverse environmental effects;
- a description of any residual adverse environmental effects and any modified or additional measures required by the Proponent to mitigate residual adverse environmental effects;
- details concerning the implementation of the emergency response plan referred to in condition 9.3; and

Furthermore, a written report will be submitted to the Agency, no later than 90 days after the day on which the accident or malfunction took place, on the changes made to avoid a subsequent occurrence of the accident or malfunction, and on the implementation of any modified or additional measures to mitigate and monitor residual adverse environmental effects and to carry out any required progressive reclamation, taking into account the information in the written report submitted within 30 days of the accident or malfunction.

These reports will be published on the Company's website, https://www.centerragold.com/operations/kemess.

3.6 COMMUNICATION PLAN REVISIONS

TKN and Gitxsan Wilp Nii Kyap will be notified and consulted about revisions to the Accidents and Malfunctions Communications Plan. This Plan, and any amendments thereto, will be developed and implemented throughout Construction, Operations, Closure and Post Closure to the satisfaction of EAO.

In addition to the reciprocal obligation to notify parties of changes to contact information, AuRico and the TKN through the IBA have committed to an annual review of Management Plans and that commitment applies to this Plan.

REFERENCES

Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

1985a. *Fisheries Act*, RS. C. F-14. s. 1.

1985b. *Hazardous Materials Information Review Act*, RSC. C. 24 (3rd Supp.), Part III. s. 9.

1985c. *Hazardous Products Act,* RSC. C. H-3.

1992. *Transportation of Dangerous Goods Act,* SC. C. 34.

1996a. *Mines Act*, RSBC. C. 293.

1996b. *Workers Compensation Act,* RSBC. C. 492.

1999. *Canadian Environmental Protection Act, 1999,* SC. C. 33.

2002. *Environmental Assessment Act,* RSBC. C. 43.

2003. *Environmental Management Act,* SBC. C. 53.

2012. *Canadian Environmental Assessment Act, 2012,* SC. C. 19. s. 52.

Workplace Hazardous Materials Information System Regulation (Mines), BC Reg. 257/88.

Spill Reporting Regulation, BC Reg. 263/90.

Occupational Health and Safety Regulation, BC Reg. 296/97.

Controlled Products Regulations SOR/88-66.

Transportation of Dangerous Goods Regulations, SOR/2001-286.

Environmental Emergency Regulations, SOR/2003-307.